SUBSURFACE

ORIGINAL

DUKE ENERGY OF INDIANA, INC.
EDWARDSPORT IGCC STATION
EDWARDSPORT, INDIANA

CLASS I UIC PERMIT APPLICATION

SUBSURFACE

LETTER OF TRANSMITTAL

TO: Mr. Bill Bates

USEPA Region 5
Underground Injection Control Branch

77 West Jackson Boulevard

Chicago, Illinois 60604-3590

DATE: 5/20/08	JOB NO.: NODs Response
ATTENTION: Bill Bates	
RE: Response to NODs & Change Out Pages	
Duke Energy Indiana	

WE ARE SENDING YOU

[X] Attached

[ ] Under separate cover via the following items:

[ ] Contract Documents
[ ] Purchase Order
[ ] Waiver of Lien
[ ] Laboratory Analysis Report
[ ] Certificates of Insurance
[X] Copies of Reports
[ ] Bid Form & Plans
[ ] Other -

COPIES	DATE	NO.	DESCRIPTION
1 Set	5/20/08		Edwardsport NODs Response Letter & Change Out Pages

THESE ARE TRANSMITTED as checked below:

[ ] For Approval
[X] For Your Use
[ ] For Review and Comment
[ ] Approved As Submitted
[ ] Other:
[ ] Sign and Return
[ ] Approved As Noted
[ ] As Requested
[ ] Returned For Corrections

REMARK:

SIGNED: Richard W. Schildhouse
Richard W. Schildhouse
Engineer
RW

SUBSURFACE

RECEIVED

MAY 21 2008

UIC BRANCH
EPA REGION 5

May 19, 2008

Ms. Rebecca Harvey, Chief
Underground Injection Control Branch
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Re: Response to NODs – Duke Energy Indiana, Inc. – Edwardsport Generating Station – Permit No. IN-083-1I-0001

Dear Ms. Harvey:

The following is a listing of Notices of Deficiency (NODs) submitted to Mr. Robert Burch of Duke Energy by your office in a letter dated March 3, 2008. For convenience, agency comments are repeated in bold with responses following in italics. Various permit application "change-out" pages, as appropriate, are attached.

In Attachment D (page D-3): Mitchell and Rupp, 1994 is sited within the text. However, this reference is not cited in the reference section of Attachment D. Please add Mitchell and Rupp to the reference section.

This reference was included in Attachment F and will be added to the reference section for Attachment D. Please see attached change-out page D-3.

Attachment D; (page D-3): text states that the lowest known USDW is the Linton Formation, but Figure D-1 suggests that the deepest USDW is the Seelyville Coal Member of the Staunton Formation. Please correct the Figure or the text, whichever one is correct.

The Attachment D text is correct. Figure D-1 has been corrected to match the text language. Please see attached change-out Figure D-1.

Attachment F; Table F.5-1: There is no legend that defines the abbreviations after the magnitudes in the table.

Information regarding abbreviations used in the table can be found at http://neic.usgs.gov/neis/epic/code magnitude.html and at http://neic.usgs.gov/neis/bulletin/symbols.html.

Attachment F; Figure F.1-3: The black dots on the figure are not identified. Please include a legend that describes the black dots.

According to the text referenced, the "black dots" are test well locations. A legend has been added to the figure. Please see attached change-out Figure F.1-3.

Attachment F; Figure F.1-4: In Will County Illinois there is a fault near the Sandwich fault. The downthrown side is opposite the Sandwich fault. Is this correct.

Yes – according to review of published material from which this data was obtained - this is correct. No change to the previously submitted text is required.

Attachment F; most F.2 figures: There are no units for the isopach contours. Please provide new figures with units on contours or a way to determine contour intervals.

Unit information has been added to the figures. Please see attached applicable change-out figures from Attachment F.

Attachment F; Drawing F-1 and F-2: The format of the cross-sections is not easily used. Please supply cross-sections in a useable format. Please also include copies of the logs that were used to make the determination.

Per a phone conversation to clarify this comment between William Bates and Subsurface geologists, agreed upon changes have been made to the cross-sections. Please see attached amended Drawings F-1 and F-2; an electronic copy of the drawing files is also attached as requested in the phone conversation.

Attachment F; Drawing F-1: The north-south cross section stops north of the proposed well site. If possible please include information from a well south of the proposed site.

At the time of application preparation and submittal, a data point further south of the proposed drill site was not available. Since that time, Duke – Gibson Generating Station WDW#1 in Gibson County, Indiana has been completed. Data from this well has been added to the north-south cross section. Please see the attached amended Drawing F-1.

Attachment H (Page H-1): There is no explanation for the formula shown.

Please refer to attached change-out page H-1 for revisions.

Attachment H (Page H-1): There is no explanation of why 150gpm was used and how that relates to 234psi.

From experience with injection into "hard rock" geology in the Midwest Continental United States, 150gpm is a good upper limit injection rate that can be sustained for a reasonable operational life of an injection well. This rate figures in to friction loss estimates. Please refer to attached change-out pages H-1 and page 2 of Appendix P-1 for revisions. The 234psi should be 233psi – change in pressure as illustrated in the Matthews and Russell text.

Attachment I (Page I-2): The last sentence of the page states that "permeability measurements will be run utilizing methods with a high range of accuracy." However, there is no decision on what those methods are. Please state what methods are planned on being used.

Permeability will be calculated from Resistivity and Porosity logs and recorded on the Complex Reservoir Analysis log.

No change to the previously submitted text has been made.

Attachment K (Page K-2): There needs a better description of the alarm and shut-off systems. This should include a value lower than the MIP. Something like alarm will trigger at MIP-75 psi and shut-off will trigger at MIP-25 psi.

Since the regulation states that the annulus pressure is to be kept a minimum of 100psi over the injection pressure, the annulus pressure will have a maximum of 150psi above the MASIP. The annulus pressure pump will start when pressure drops to 50psi above the MASIP. The alarm and shutdown will occur when the annulus pressure drops below 25psi over the MASIP (assumption being that normal injection pressure is at least 100 psi below MASIP).

Please see attached change-out page K-2.

Attachment L; Table L-2: There needs to be a fracture finder log run after the drilling for the intermediate level.

This requirement has been added. Please see attached change-out Table L-2.

Attachment M; Table M-1: There needs to be some discussion on the location of the DV tool for the 5000 ft intermediate string option.

Discussion has been added. Please see attached change-out Table M-1.

Attachment P; WAP (page 3; section 2.1): Sampling frequency indicates annually sampling. This is not adequate. The sampling frequency should be monthly.

Duke Energy believes quarterly sampling to be more appropriate. Please see attached change-out WAP Page 3.

Attachment P; WAP (page 4; section 2.4.1): The first paragraph indicates that a duplicate sample will be collected once a year. Duplicates should be collected with each sample.

Industry standards indicate that duplicate samples are generally obtained per sampling event when multiple samples are being collected. For example – one duplicate sample is normally taken per multiple of ten different samples obtained. As the sampling required under this permit involves a single sample, obtaining a duplicate sample per sampling event seems unnecessary. No change has been made to the permit application.

Attachment P; WAP: Preservation of samples from collection to lab is not discussed. Please provide a description of how samples will be preserved from collection to the lab.

Please refer to WAP Sections 2.6, 2.7 and 2.8.

Attachment P; WAP (page 8, section 3.2): The first sentence of the section 3.2 states that the selected parameters are representative for monitoring and waste characterization. However, there is no discussion on why it is believed that these parameters are representative. Please provide a narrative on why these parameters are representative.

These parameters were chosen based on USEPA Region 5 sampling requirements as stated in previous permits for similar non-hazardous wastestreams and appear to be reasonable given projected wastestream constituents as presented in Appendix A of the WAP. If additional parameters are required, these can be listed in the permit.

Attachment P; WAP (page 9; section 4.1.1): It is stated that equipment blanks are not needed. We feel this is not appropriate. Therefore, EPA requests that equipment blanks be run.

The text states that dedicated sampling equipment will be used. Industry standards related to equipment blanks indicate this is required only when non-dedicated sampling equipment is utilized between multiple sampling points.

Attachment P; WAP: There is no discussion on monitoring report that will be sent to the EPA. Please provide a narrative on the format and timing of the EPA report.

It is anticipated that the permit will require the following information to be reported monthly: total gallons for month; average daily rate per days operated; maximum *injection pressure; maximum injection rate; normal injection pressure; normal injection rate; number of days operated; cumulative volume to date; normal annulus pressure; and a discussion of any unusual circumstances encountered during the reporting month.*

We are not aware that such a discussion is required in a WAP document and have never experienced this request in the completion of numerous past applications. This requirement is usually stated by USEPA in the permit.

Attachment Q (page Q-1): Please note that the plug for the base of the surface casing does not extend deep enough. Base of surface casing plug needs 50 feet below the surface casing to 50 feet above the base of the lowest USDW. This does not need to be corrected at this time. However, this needs to be corrected at the time the completion report is completed.

Noted.

Attachment R: Currently there is no financial assurance related to this facility.

This information had been sent previously to the EPA directly from Duke Energy. A copy of the letters are attached.

Subsurface appreciates the opportunity to respond to agency questions and Subsurface trusts this information satisfies the stated Notices of Deficiency. Please note additional change-out pages included with this correspondence that should replace similarly labeled pages in the document in your possession. Please do not hesitate to contact the undersigned should you require any additional information or clarification.

Sincerely,

Subsurface Technology, Inc.

Richard W. Schildhouse RV

Richard W. Schildhouse
Engineer

Attachments

RWS/rv

Checklist of Testing Requirements in New Class I Non-Hazardous Injection Wells (40 CFR 146.13)

Facility:	Well:
Permit Number:	Reviewer:
Date of Drilling Plan:	Date of Review:

40 CFR 146.13 Requirements	Acceptable?
(d) Appropriate logs and tests shall be conducted during the drilling and construction of new Class I wells. A descriptive report interpreting results of such logs and tests shall be prepared by a knowledgeable log analyst and submitted to the Director. At a minimum, such logs and tests shall include:	
(1) Deviation checks if a reamed hole	
(2) Such other logs as may be needed given availability of similar data: at a minimum:	
(i) upon installation of surface casing:	
(A) resistivity, SP, caliper	
(B) CBL, variable density or temperature log	
(ii) upon installation of intermediate casings:	
(A) resistivity, SP, porosity, caliper, gamma ray	
(B) Fracture finder logs	
(B) CBL, variable density or temperature log	
(ii) upon installation of longstring casings:	
(A) resistivity, SP, porosity, caliper, gamma ray	
(B) Fracture finder logs	
(B) CBL, variable density or temperature log	
(e) At a minimum, the following information concerning the injection formation shall be determined or calculated for new Class I wells:	
(1) Fluid pressure	
(2) Temperature	
(3) Fracture pressure	
(4) Other physical and chemical characteristics of the injection matrix; and	
(5) Physical and chemical characteristics of the formation fluids	

146.14(a)(8) requires submission of the "Proposed formation testing program to obtain an analysis of the chemical, physical and radiological characteristics of and other information on the receiving formation". 146.14(a)(15) requires submission of "Construction procedures including a cementing and casing program, logging procedures, deviation checks, and a drilling, testing and coring program". Coring is not mentioned elsewhere in the Class I non-haz regs.

Waste Analysis Plan Review Sheet
Based on R5UIC Guidance #8, dated 1/21/94
January 3, 2001

Permit Number(s)			Haz/Non-haz
Permittee		Date of WAP	
Reviewer		Date of Review	

A. Waste Characterization

1. Hazardous Waste - Minimum Requirements

a. Hazardous Waste from Specific and Non-specific sources: monthly analysis
List any waste codes:

Listed Wastes (F, K, P and U codes)	Frequency

Sampling Location	

Was wastestream tested for all likely constituents? Compare with list at 40 CFR 268.41 for extracts and 40 CFR 268.43 for waste waters.	
If No, was an adequate explanatory statement (signed and certified per 40 CFR 144.32) submitted?	

b. Hazardous Waste Defined by Characteristic Only: monthly analysis
Tests for toxicity must use the TCLP (40 CFR 261.24) and should include all constituents which might cause the waste to be characteristically hazardous.

Characteristic Wastes (D codes)	Frequency
D001 -Ignitability: flash point < 60°C : see 40 CFR 261.21	
D002 - Corrosivity: pH < 2 or > 12.5; or corrodes steel at 6.35 mm/yr: see 40 CFR 261.22	
D003 - Reactivity: unstable; reacts with water, generates toxic gases when mixed with water, cyanide or sulfide bearing; explosive: see 40 CFR 261.23	
List any other D codes: see 40 CFR 261.24, Table 1	

Characteristic	Suggested Frequency	WAP Frequency
pH	daily	
Eh	daily	
Specific conductance	daily	
Specific gravity	daily	
Temperature	daily	
TDS	monthly	
Total organic carbon (TOC)	monthly	

All other constituents of the wastestream which constitute more than 0.01% by mass (equal to or greater than 100 ppm) should be analyzed monthly. Every new source of waste must be similarly analyzed prior to injection. This is particularly important at any commercial Class I non-hazardous facility.

Is waste characterization adequate?	

3. Parameters Also Included in an Approved UIC-Required Groundwater Monitoring Plan (GMP)
a. At facilities conducting groundwater monitoring following an approved GMP, all parameters included in the GMP analyses should be among those tested for in the waststream. For comparison between the injected waste and the groundwater, at a minimum, these parameters must include:

Constituent	Included?
Sodium	
Calcium	
Magnesium	
Potassium	
Bicarbonate	
Sulfate	
Chloride	

b. Additional parameters: Depending on the wastestream, additional parameters may be necessary to characterize the waste adequately. Guidance #8 suggests isotopic parameters, such as ^{18}O, ^{2}H, ^{13}C, ^{34}S,^{37}Cl,^{3}H,^{14}C; additional elements or compounds including metals, halogens, non-volatile, semi-volatile and volatile organic constituents.

B. Quality Assurance and Quality Control

The following elements should be included:

Element	Included?
Equipment cleaning blanks	
Trip blanks	
Sample duplicates	
Sample chain-of-custody protocol	
Equipment calibration	
Data reduction	
Data validation	
Internal quality control	
Laboratory audits	
Corrective actions	
Reports to USEPA	

Is QA/QC adequate?	

SUBSURFACE

PERMIT APPLICATION FOR
CLASS I NON-HAZARDOUS INJECTION WELL

DUKE ENERGY INDIANA, INC.
EDWARDSPORT IGCC STATION
EDWARDSPORT, INDIANA

SUBSURFACE PROJECT NO. 60F5923

REPORT SUBMITTED
MARCH 2007
REVISED APRIL 2008

PREPARED BY

SUBSURFACE TECHNOLOGY, INC.
SOUTH BEND, INDIANA

SUBSURFACE

ORIGINAL

PERMIT APPLICATION FOR CLASS I NON-HAZARDOUS INJECTION WELL

DUKE ENERGY OF INDIANA, INC.
EDWARDSPORT IGCC STATION
EDWARDSPORT, INDIANA

SUBSURFACE PROJECT NO. 60F5923

REPORT SUBMITTED
MARCH 2007

PREPARED BY

SUBSURFACE TECHNOLOGY, INC.
SOUTH BEND, INDIANA

File:rv/Duke Energy, Inc.-Edwardsport-5923-permit app

TABLE OF CONTENTS

ATTACHMENT E: (DOES NOT APPLY TO CLASS I WELLS)

ATTACHMENT F: MAPS AND CROSS-SECTIONS OF GEOLOGIC STRUCTURE OF AREA

FIGURES

DRAWINGS

APPENDIX

INTRODUCTION

INTRODUCTION

Duke Energy Indiana, Inc. (DEI) is making application to the United States Environmental Protection Agency (USEPA) for a permit to drill and operate eight (8) Class I non-hazardous injection wells at their Edwardsport IGCC Station in Edwardsport, Indiana. The proposed injection wells are to be used for disposal of an aqueous blowdown waste associated with a coal gasification electrical power generating facility. As the facility has not been constructed as of the date of this permit application, some of the injectate information provided is based on a demonstration plant in the Tampa, Florida area and via design work by the General Electric Company as the owner of this technology. Additional information related to Class I injection wells is based on DEI's experience at their Gibson Generating Station in Owensville, Indiana. Well locations, as specified on the application form, are subject to change as facility construction plans are finalized.

Due to a general lack of site-specific geology in the immediate area of the proposed facility, Duke is proposing to complete wells within a "target zone" that will include the area beginning with the Trenton formation and ending with the Mt. Simon formation.

The proposed wells will operate under the USEPA Underground Injection Control (UIC) Program (40 CFR 146).

Enclosed in this permit application are the appropriate USEPA forms along with designated attachments. Attachments are keyed to the letter designations indicated on the standard permit application form. To ease agency review, the application has been prepared to the format outlined in the USEPA Region 5 Permit Application Checklist for Class I Injection Wells in Michigan/Indiana (completed checklist included in final tab).

As requested by USEPA Region 5 UIC Section personnel, eight (8) separate application forms are attached (one for each proposed well) and eight (8) separate plugging and abandonment forms (one for each proposed well) are included along with one (1) set of attachments.

INTRODUCTION

Duke Energy of Indiana, Inc. (Duke) is making application to the United States Environmental Protection Agency (USEPA) for a permit to drill and operate eight (8) Class I non-hazardous injection wells at their Edwardsport IGCC Station in Edwardsport, Indiana. The proposed injection wells are to be used for disposal of an estimated maximum 720 gallons per minute aqueous blowdown waste associated with a coal gasification electrical power generating facility. As the facility has not been constructed as of the date of this permit application, some of the information provided is based on similar Duke experience at their Gibson Generating Station in Owensville, Indiana. Well locations, as specified on the application form, are subject to change as facility construction plans are finalized.

Due to a general lack of site-specific geology in the immediate area of the proposed facility, Duke is proposing to complete wells within a "target zone" that will include the area beginning with the Trenton formation and ending with the Mt. Simon formation.

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PERMIT APPLICATION

OMB No. 2040-0042 Approval Expires 4/30/07

EPA

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

I. EPA ID Number		T/A	C
U			

Read Attached Instructions Before Starting

For Official Use Only

Application approved (mo day year)	Date received (mo day year)	Permit Number	Well ID	FINDS Number

II. Owner Name and Address			III. Operator Name and Address		
Owner Name: Duke Energy Indiana, Inc.			Owner Name: Duke Energy Indiana, Inc. - Edwardsport IGCC Station		
Street Address: 1000 East Main Street		Phone Number: (317) 838-1729	Street Address: 15400 Villwock Road		Phone Number: (812) 735-5444
City: Plainfield	State: IN	ZIP CODE: 46168	City: Edwardsport	State: IN	ZIP CODE: 47528

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
☐ Yes ☒ No	☒ Private ☐ Federal ☐ Other	☒ Owner ☐ Operator	4911 Electrical Services

VIII. Well Status *(Mark "x")*

☐ A Operating	Date Started (mo day year)	☐ B. Modification/Conversion	☒ C. Proposed

IX. Type of Permit Requested *(Mark "x" and specify if required)*

	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
☒ A. Individual ☐ B. Area	0	8	Edwardsport IGCC Station - WDW #2

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
I	I	--------	--------

XI. Location of Well(s) or Approximate Center of Field or Project

Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line
38	48	0	87	14	49	12	4N	8W	NE	711	N	793	W

XII. Indian Lands (Mark 'x')

☐ Yes
☒ No

XIII. Attachments

(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)

For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.

XIV. Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32)

A. Name and Title (Type or Print)	B. Phone No. (Area Code and No.)
Jack Stultz GM IGCC	812-231-6791
C. Signature	**D. Date Signed**
Jack Stultz	6/7/2007

EPA Form 7520-6 (Rev. 8-01)

OMB No. 2040-0042 Approval Expires 4/30/07

EPA

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

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Owner Name			
Duke Energy Indiana, Inc.			
Street Address		**Phone Number**	
1000 East Main Street		(317) 838-1729	
City	**State**	**ZIP CODE**	
Plainfield	IN	46168	

III. Operator Name and Address

Owner Name		
Duke Energy Indiana, Inc. - Edwardsport IGCC Station		
Street Address		**Phone Number**
15400 Villwock Road		(812) 735-5444
City	**State**	**ZIP CODE**
Edwardsport	IN	47528

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
☐ Yes ☒ No	☒ Private ☐ Federal ☐ Other	☒ Owner ☐ Operator	4911 Electrical Services

VIII. Well Status *(Mark "x")*

☐ A Operating	Date Started (mo day year)	☐ B. Modification/Conversion	☒ C. Proposed

IX. Type of Permit Requested *(Mark "x" and specify if required)*

	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
☒ A. Individual ☐ B. Area	0	8	Edwardsport IGCC Station - WDW #3

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
I	I	--------	--------

XI. Location of Well(s) or Approximate Center of Field or Project

Latitude			Longitude			Township and Range							
Deg	Min	Sec	Deg	Min	Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line
38	48	0	87	14	55	12	4N	8W	NE	697	N	331	W

XII. Indian Lands (Mark 'x')

☐ Yes
☒ No

XIII. Attachments

(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)

For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.

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A. Name and Title *(Type or Print)*	B. Phone No. *(Area Code and No.)*
Jack Stultz GM IGCC	812-231-6791
C. Signature	**D. Date Signed**
Jack Stultz	6/7/07

EPA Form 7520-6 (Rev. 8-01)

OMB No. 2040-0042 Approval Expires 4/30/07

EPA

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

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☐ Yes ☒ No	☒ Private ☐ Federal ☐ Other	☒ Owner ☐ Operator	4911 Electrical Services

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IX. Type of Permit Requested *(Mark "x" and specify if required)*

☒ A. Individual	☐ B. Area	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
		0	8	Edwardsport IGCC Station - WDW #4

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
I	I	--------	--------

XI. Location of Well(s) or Approximate Center of Field or Project / **XII. Indian Lands (Mark 'x')**

Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Township and Range Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line	XII. Indian Lands
38	48	0	87	15	1	12	4N	8W	NW	721	N	135	E	☐ Yes ☒ No

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JACK Stultz GM IGCC	812-231-6791
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Jack Stultz	6/7/07

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City	State	ZIP CODE	
Edwardsport	IN	47528	

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
☐ Yes ☒ No	☒ Private ☐ Federal ☐ Other	☒ Owner ☐ Operator	4911 Electrical Services

VIII. Well Status *(Mark "x")*

☐ A Operating	Date Started (mo day year)	☐ B. Modification/Conversion	☒ C. Proposed

IX. Type of Permit Requested *(Mark "x" and specify if required)*

☒ A. Individual ☐ B. Area	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
	0	8	Edwardsport IGCC Station - WDW #5

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
I	I	--------	--------

XI. Location of Well(s) or Approximate Center of Field or Project

Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line
38	48	0	87	15	7	12	4N	8W	NW	716	N	663	E

XII. Indian Lands (Mark 'x')

☐ Yes
☒ No

XIII. Attachments

(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)

For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.

XIV. Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

A. Name and Title *(Type or Print)*	B. Phone No. *(Area Code and No.)*
Jack Stultz GM IGCC	812-231-6791
C. Signature	D. Date Signed
Jack Stultz	6/7/07

OMB No. 2040-0042 Approval Expires 4/30/07

EPA

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

I. EPA ID Number | T/A | C | U

Read Attached Instructions Before Starting

For Official Use Only

Application approved (mo day year)	Date received (mo day year)	Permit Number	Well ID	FINDS Number

II. Owner Name and Address			III. Operator Name and Address		
Owner Name: Duke Energy Indiana, Inc.			Owner Name: Duke Energy Indiana, Inc. - Edwardsport IGCC Station		
Street Address: 1000 East Main Street		Phone Number: (317) 838-1729	Street Address: 15400 Villwock Road		Phone Number: (812) 735-5444
City: Plainfield	State: IN	ZIP CODE: 46168	City: Edwardsport	State: IN	ZIP CODE: 47528

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
[ ] Yes [x] No	[x] Private [ ] Federal [ ] Other	[x] Owner [ ] Operator	4911 Electrical Services

VIII. Well Status *(Mark "x")*

[ ] A Operating — Date Started (mo day year):

[ ] B. Modification/Conversion

[x] C. Proposed

IX. Type of Permit Requested *(Mark "x" and specify if required)*

[x] A. Individual [ ] B. Area	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
	0	8	Edwardsport IGCC Station - WDW #6

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
I	I	--------	--------

XI. Location of Well(s) or Approximate Center of Field or Project

Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line
38	48	6	87	15	10	12	4N	8W	NW	172	N	892	E

XII. Indian Lands (Mark 'x')

[ ] Yes

[x] No

XIII. Attachments

(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)

For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.

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A. Name and Title *(Type or Print)*	B. Phone No. *(Area Code and No.)*
JACK Stultz GM IGCC	812 231 6791
C. Signature	**D. Date Signed**
Jack Stultz	6/7/07

EPA Form 7520-6 (Rev. 8-01)

OMB No. 2040-0042 Approval Expires 4/30/07

EPA

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

I. EPA ID Number		T/A	C
U			

Read Attached Instructions Before Starting

For Official Use Only

Application approved (mo day year)	Date received (mo day year)	Permit Number	Well ID	FINDS Number

II. Owner Name and Address			III. Operator Name and Address		
Owner Name: Duke Energy Indiana, Inc.			Owner Name: Duke Energy Indiana, Inc. - Edwardsport IGCC Station		
Street Address: 1000 East Main Street		Phone Number: (317) 838-1729	Street Address: 15400 Villwock Road		Phone Number: (812) 735-5444
City: Plainfield	State: IN	ZIP CODE: 46168	City: Edwardsport	State: IN	ZIP CODE: 47528

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
☐ Yes ☒ No	☒ Private ☐ Federal ☐ Other	☒ Owner ☐ Operator	4911 Electrical Services

VIII. Well Status *(Mark "x")*

☐ A Operating	Date Started (mo day year)	☐ B. Modification/Conversion	☒ C. Proposed

IX. Type of Permit Requested *(Mark "x" and specify if required)*

☒ A. Individual ☐ B. Area	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
	0	8	Edwardsport IGCC Station - WDW #7

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
I	I	--------	--------

XI. Location of Well(s) or Approximate Center of Field or Project

Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line
38	47	39	87	15	15	12	4N	8W	NW	870	N	1284	E

XII. Indian Lands (Mark 'x')

☐ Yes
☒ No

XIII. Attachments

(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)

For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.

XIV. Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

A. Name and Title *(Type or Print)*	B. Phone No. *(Area Code and No.)*
Jack Stultz GM IGCC	812 231 6791
C. Signature	**D. Date Signed**
Jack Stultz	6/7/07

EPA Form 7520-6 (Rev. 8-01)

OMB No. 2040-0042 Approval Expires 4/30/07

EPA

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

I. EPA ID Number

	T/A	C
U		

Read Attached Instructions Before Starting

For Official Use Only

Application approved (mo day year)	Date received (mo day year)	Permit Number	Well ID	FINDS Number

II. Owner Name and Address

Owner Name			
Duke Energy Indiana, Inc.			
Street Address		**Phone Number**	
1000 East Main Street		(317) 838-1729	
City	**State**	**ZIP CODE**	
Plainfield	IN	46168	

III. Operator Name and Address

Owner Name			
Duke Energy Indiana, Inc. - Edwardsport IGCC Station			
Street Address		**Phone Number**	
15400 Villwock Road		(812) 735-5444	
City	**State**	**ZIP CODE**	
Edwardsport	IN	47528	

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
☐ Yes ☒ No	☒ Private ☐ Federal ☐ Other	☒ Owner ☐ Operator	4911 Electrical Services

VIII. Well Status *(Mark "x")*

☐ A Operating	Date Started (mo day year)	☐ B. Modification/Conversion	☒ C. Proposed

IX. Type of Permit Requested *(Mark "x" and specify if required)*

☒ A. Individual ☐ B. Area	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
	0	8	Edwardsport IGCC Station - WDW #8

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
I	I	--------	--------

XI. Location of Well(s) or Approximate Center of Field or Project

Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line
38	47	54	87	15	10	12	4N	8W	NW	1337	N	899	E

XII. Indian Lands (Mark 'x')

☐ Yes
☒ No

XIII. Attachments

(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)

For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.

XIV. Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibliity of fine and imprisonment. (Ref. 40 CFR 144.32)

A. Name and Title *(Type or Print)*	B. Phone No. *(Area Code and No.)*
JACK Stultz GM IGCC	812-231-6791
C. Signature	**D. Date Signed**
Jack Stultz	6/7/07

EPA Form 7520-6 (Rev. 8-01)

ATTACHMENT A

AREA OF REVIEW

APR 2008

A. AREA OF REVIEW

The Edwardsport site is an area of approximately 500 acres . The present facility is located at 87° 14' 47.31" W; 38° 48' 25.54" N. The proposed coal gasification facility and wells will be located in the general vicinity of 87° 14' 55.4" W; 38° 47' 53.1"N.

The radius of the area of review (AOR) for non-hazardous wells was established by Environmental Protection Agency Region 5 Guidance as "a fixed radius of 2 miles" around the proposed well location. In the case of this application, the centroid of the proposed 8 well locations was used as the center point for fixing the 2 mile AOR. This is consistent with past approved USEPA Class I Permit Applications where multiple wells were proposed. The AOR comprises all or part of Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23 and 24 of T4N, R8W and Sections 35 and 36 of T5N, R8W (Knox County) and Sections 5, 6, 7, 8, 17, 18 and 19 of T4N, R7W and Section 32 of T5N, R7W (Davies County).

A. AREA OF REVIEW

The Edwardsport site is an area of approximately 500 acres . The present facility is located at 87° 14' 47.31" W; 38° 48' 25.54" N. The proposed coal gasification facility and wells will be located in the general vicinity of 87° 14' 55.4" W; 38° 47' 53.1"N.

The radius of the area of review (AOR) for non-hazardous wells was established by Environmental Protection Agency Region 5 Guidance as "a fixed radius of 2 miles" around the proposed well location. The AOR comprises all or part of Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23 and 24 of T4N, R8W and Sections 35 and 36 of T5N, R8W (Knox County) and Sections 5, 6, 7, 8, 17, 18 and 19 of T4N, R7W and Section 32 of T5N, R7W (Davies County).

ATTACHMENT B

MAPS OF WELLS/AREA OF REVIEW

B. MAPS OF WELLS/AREA OF REVIEW

Maps

Figure B-1 is a copy of a U.S. Geological Survey (USGS) 7½ minute series topographic map of the area with the AOR for the proposed injection wells identified. In addition to the AOR boundary, all freshwater and non-freshwater artificial penetrations, and RCRA TSD facilities located within the AOR, the property boundary of the facility, and all surface features are shown on subsequent figures. There are no known faults within the AOR. The boundaries of a relatively shallow coal mine beneath the site are illustrated on Figure B-2. Wells will be sited either 1) away from the mine; 2) within sufficiently large and stable columns in the mine; 3) the mine overburden will be removed and the mine cavity filled prior to well drilling; or 4) the mine will be filled by injecting grout. Figures B-3 and B-4 serve as index maps indicating locations of regional cross-sections found in Attachment F as Drawings F-2 and F-3. Figure B-5 indicates the location of non-freshwater wells within the AOR, while Figure 6 indicates the location of fresh water wells within the AOR.

Adjacent Land Owners

The following is a list of abutting property landowners:

Bradley J. Summers
6709 N. Sceptor
Bicknell, Indiana 47512

Ralph R. & Anna M. Alford
15332 E. Villwock Road
Edwardsport, Indiana 47528

Joan V. Akers
P.O. Box 1051
Mayer, Arizona 86333

Growers Cooperative, Inc.
P.O. Box 2196
Terre Haute, Indiana 47802

Carl & Virginia Villwock
15442 E. Villwock Road
Edwardsport, Indiana 47528

IOOF Cemetery Association of Edwardsport
P.O. Box 222
Edwardsport, Indiana 47528

Floyd Raymon Summers Revocable Trust
7800 N. Summers Road
Edwardsport, Indiana 47528

John R. & Mary R. Tribby
8163 N. SR 358
Edwardsport, Indiana 47528

US Railroad Vest. Corp.
108 N. Main Street
South Bend, Indiana 46601

Carl Thomas & Melissa Houghland
8109 N. SR 358
Edwardsport, Indiana 47528

Herman & Anna Mae & Joe Ed Koenig
8291 N. Pieper Road
Edwardsport, Indiana 47528

Joe Ed & Virginia Kay Koenig
15231 E. Villwock Road
Edwardsport, Indiana 47528

Nathaline Killion
P.O. Box 200
Edwardsport, Indiana 47528

Benjamin M. Summers Trust
P.O. Box 212
Edwardsport, Indiana 47528

Robert Summers
7849 N. Summers Road
Edwardsport, Indiana 47528

Joseph Catt
P.O. Box 46
Westphalia, Indiana 47596

State of Indiana
100 North Senate Avenue
Indianapolis, Indiana 46204

Michael B. Carnahan
16091 E. Farmstead Road
Edwardsport, Indiana 47528

Susan Dee Bunte
P.O. Box 60
Freelandville, Indiana 47535

Mary Ann Villwock
P.O. Box 162
Bicknell, Indiana 47512

Donald & Joyce Villwock
15810 E. SR 358
Edwardsport, Indiana 47528

Russell H. & Freida V. Buck
15457 E. SR 358
Edwardsport, Indiana 47528

Robert Summers & Sons, Inc.
7849 N. Summers Road
Edwardsport, Indiana 47528

Randy R. & Kathy J. Summers
8070 N. Summers Road
Edwardsport, Indiana 47528

Summers Family Farm, Inc.
P.O. Box 212
Edwardsport, Indiana 47528

Max W. & Janet R. Haney
201 3rd Street
Edwardsport, Indiana 47528

Max W. Jr & Diane Haney
575 Old Hwy 13
Harrisburg, Illinois 62946

Sadie Harsburg
P.O. Box 18
Westphalia, Indiana 47596

Karen Carter Like
P.O. Box 71
Edwardsport, Indiana 47528

Melissa Evinger
209 E. Shipping Street
Edwardsport, Indiana 47528

Richard W. Sr & Sharon Knight
P.O. Box 114
Edwardsport, Indiana 47528

Rick E. & Jacqueline D. Gandy
8600 N. Ott Road
Edwardsport, Indiana 47528

Trustee of Edwardsport
United Methodist Church
P.O. Box 215
Edwardsport, Indiana 47528

Nancy Tilly
10868 N. Albrecht Road
Bicknell, Indiana 47512

Edwardsport Area Newspaper:

Vincennes Sun-Commercial
702 Main Street
Vincennes, Indiana 47591
(812) 886-9955

Hazardous Waste Treatment, Storage or Disposal (TSD) Facilities

A listing of TSD facilities in the vicinity of the Edwardsport site was obtained from the USEPA, Resource Conservation and Recovery Act, Notifier List (RCRIS) National Oversite Database. No TSD facilities are located within the AOR.

Protocol for Identifying Wells:

Non-Freshwater Records

Records for all oil and gas wells in the state of Indiana are maintained by the Indiana Department of Natural Resources (IDNR). The IDNR has two divisions of the agency that maintain oil and gas well records, the Division of Oil and Gas and the Indiana Geological Survey (IGS). The IDNR's Oil and Gas Division is primarily a regulatory agency that enforces compliance of oil and gas rules and regulations. Well permits, completions, and pluggings filed with this agency are maintained by county, township, range, and section number. At the IGS, all well records are filed by section, township and range.

Information on non-freshwater wells located in the following sections was reviewed:

Knox County, Indiana

- Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23 and 24 Township 4 North, Range 8 West
- Sections 35 and 36 Township 5 North, Range 8 West

Davies County, Indiana

- Sections 5, 6, 7, 8, 17, 18 and 19 Township 4 North, Range 7 West
- Section 32 Township 5 North, Range 7 West

A total of 30 non-freshwater wells are located in the AOR. The locations of these wells are indicated on Figure B-5. The deepest well (dry hole) was completed to depth of 2,641 feet bgl. The well does not penetrate the proposed confining zone. Table B-1 is a listing of all dry and abandoned /or plugged wells and producing wells located within the AOR.

Freshwater Records

Water well records available for the State of Indiana are maintained by the IDNR's Division of Water, in Indianapolis. The filing system used is referenced by section, township, and range.

Information on freshwater wells located in the following sections was reviewed:

Knox County, Indiana

- Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23 and 24 Township 4 North, Range 8 West
- Sections 35 and 36 Township 5 North, Range 8 West

Davies County, Indiana

- Sections 5, 6, 7, 8, 17, 18 and 19 Township 4 North, Range 7 West
- Section 32 Township 5 North, Range 7 West

A total of 20 freshwater wells are located in the AOR. The locations of the wells are indicated on Figure B-6. The deepest well is 250 feet deep. The well does not penetrate the proposed confining zone.

TABLE

TABLE B-1
NON-FRESHWATER WELLS
WITHIN THE AREA OF REVIEW (AOR)

IGS ID	County	Section	Twp	Dir.	Rng	Dir.	Depth	Status	TD Formation
101248	Daviess	5	4	N	7	W	1054	Dry	Ste. Genevieve
101250	Daviess	6	4	N	7	W	2641	Dry	Silurian
101251	Daviess	7	4	N	7	W	1081	Dry	Ste. Genevieve
101252	Daviess	7	4	N	7	W	1061	Salt Water Disposal	Ste. Genevieve
101253	Daviess	7	4	N	7	W	1054	Abandoned Oil	Ste. Genevieve
101254	Daviess	7	4	N	7	W	1062	Dry	Ste. Genevieve
101255	Daviess	7	4	N	7	W	1135	Dry	Ste. Genevieve
101256	Daviess	8	4	N	7	W	1530	Dry	Salem
101257	Daviess	8	4	N	7	W	1567	Salt Water Disposal	Salem
101258	Daviess	8	4	N	7	W	1070	Dry	Ste. Genevieve
101259	Daviess	8	4	N	7	W	1057	Oil	Ste. Genevieve
101260	Daviess	8	4	N	7	W	1500	Dry	Salem
101261	Daviess	8	4	N	7	W	1074	Dry	Ste. Genevieve
133463	Daviess	8	4	N	7	W	1483	Dry	Salem
133464	Daviess	8	4	N	7	W	1160	Water Injection	Ste. Genevieve
101296	Daviess	18	4	N	7	W	1090	Dry	Ste. Genevieve
101298	Daviess	19	4	N	7	W	1772	Dry	Harrodsburg
123031	Knox	1	4	N	8	W	1312	Dry	Ste. Genevieve
123035	Knox	3	4	N	8	W	1255	Dry	Ste. Genevieve
123036	Knox	3	4	N	8	W	1298	Dry	Ste. Genevieve
123043	Knox	11	4	N	8	W	1186	Dry	Ste. Genevieve
123044	Knox	12	4	N	8	W	1185	Dry	Ste. Genevieve
123045	Knox	12	4	N	8	W	1200	Dry	Ste. Genevieve
123046	Knox	12	4	N	8	W	1150	Dry	Ste. Genevieve
123047	Knox	12	4	N	8	W	1238	Dry	Ste. Genevieve
101360	Daviess	13	4	N	8	W	1254	Dry	Salem
123048	Knox	13	4	N	8	W	1543	Dry	Salem
123383	Knox	35	5	N	8	W	1211	Dry	Ste. Genevieve
123384	Knox	35	5	N	8	W	1223	Dry	Ste. Genevieve
123385	Knox	36	5	N	8	W	1150	Dry	Ste. Genevieve

ATTACHMENT C

CORRECTIVE ACTION PLAN AND WELL DATA

C. CORRECTIVE ACTION PLAN AND WELL DATA

The Area of Review (AOR) for the proposed Edwardsport injection wells was established at two (2) miles as discussed in Section A.

Well records for all known wells drilled into bedrock within the AOR have been reviewed. No wells appear to have been improperly completed or plugged and abandoned that might act to transmit fluids into the lowermost underground source of drinking water (USDW). Therefore, no corrective action plan is required because there are no records indicating any artificial penetrations exist within the AOR that penetrate the confining or injection zone.

ATTACHMENT D

MAPS AND CROSS-SECTIONS OF USDW

D. AREA OF REVIEW MAPS AND CROSS SECTIONS OF USDW

Several freshwater and potential freshwater aquifers are present in the general vicinity of the Edwardsport facility. Figure D-1 is a generalized stratigraphic column identifying lithologies and characteristics of these aquifers.

Aquifers

Quaternary age valley-train deposits, outwash plain deposits, and Pennsylvanian age sandstone units form the principal aquifers in area. Valley-train deposits are confined to the White and Wabash River Valleys and form the most prolific aquifers (>1,000 gallons per minute [gpm]). Outwash plain deposits may produce 300 gpm. The Inglefield Sandstone and the Busserton Sandstone form the two major Pennsylvanian aquifers. These bedrock aquifers produce between one-half and ten gpm.

Pennsylvanian Aquifers

The principal bedrock aquifers are middle and upper Pennsylvanian fluvial and deltaic sandstones. The sandstones can occur in narrow channels or broad sheets with variable thickness. The deltaic sandstones are frequently interbedded with shales and siltstones. These sandstones have relatively low permeabilities and commonly produce four gallons per minute (gpm) (or less) of water; in many areas they constitute the only available source of drinking water. Locally, fractured limestones and coals are also used as aquifers. However, the occurrence of joints and fractures at depth is not readily predictable and they are too limited in extent to be of great importance as aquifers.

Potential aquifers in the Petersburg and Dugger Formations (Carbondale Group) are limited to localized channel and sheet sands. These channel sands were deposited with silt and mud in meandering river channels of Pennsylvanian Deltas. Wells completed in channel sandstones may produce from one to five gpm. The sheet sandstones were deposited in laterally shifting channels or as crevasse-splay deposits. These channel and sheet sandstones are limited in extend and are used as aquifers locally.

The Busseron Sandstone is the chief aquifer in the Shelburn Formation (McLeansboro Group). The Busseron Sandstone can range from 20 to 90 feet thick and is composed of gray to tan, fine to medium grained sandstone. Water yields range from one to five gpm.

The primary aquifer in the Patoka Formation is the Inglefield Sandstone member. This sandstone is light gray to buff, fine-grained, and its beds range from 20 and 40 feet thick. However, lateral lithologic changes limit its use as an aquifer. In abutting counties, the Inglefield Sandstone is included in an aquifer that includes the West Franklin Limestone. Wells completed in this sandstone may produce from three to ten gpm.

Another sandstone unit in the Patoka Formation is the Dicksburg Hills sandstone. Few wells have been completed in this unit. Most well records report this interval as sandy shale or shaly sandstone. The sandstones in the upper formations of the McLeansboro Group have not been evaluated due to the lack of available data.

Unconsolidated Aquifers

The surficial deposits in the area consist of Quaternary alluvial material overlying Pleistocene (predominantly of Illinoian age) till, outwash and valley train sands and gravels, and lacustrine silts and clays. The thickness of Illinoian and Wisconsinan drift varies from a maximum of 140 feet along the flood plain of the Wabash to less than 10 feet in the higher elevations.

The most prolific aquifers are thick valley train sands and gravels in river valleys. These deposits range from 30 to 100 feet thick and are laterally continuous parallel to the valley. Some water wells are capable of producing in excess of 1,000 gpm. The inter-till and outwash sands and gravels located outside of the river valleys tend to be less than 30 feet thick and are laterally discontinuous. Although wells capable of producing several hundred gpm are possible from these aquifers, production is generally much less.

Lowermost USDW

An Underground Source of Drinking Water (USDW) is defined as an aquifer or its portion which either supplies any public water system or contains a sufficient quantity of groundwater to supply a public water system. Potential Underground Sources of Drinking Water (USDW) are aquifers that can yield producible quantities of water that have total dissolved solids (TDS) less than 10,000 mg/l or ppm (parts per million). If an aquifer is not currently supplying drinking water for human consumption, it must contain fewer than 10,000 mg/L total dissolved solids (TDS) and not be an exempted aquifer to be considered a USDW. Since there are no exempted aquifers in the AOR and there are no aquifers supplying drinking water for human consumption that have a TDS above 10,000 mg/L, a USDW for the Edwardsport AOR is considered to be any aquifer having a TDS below 10,000 mg/L.

Only reservoirs below the lowermost USDW, within an AOR, are relevant to obtaining a Class I UIC permit. The lowermost USDW within the Edwardsport AOR is estimated at a depth of approximately 470 feet (0 MSL) within the Pennsylvanian Age bedrock by Mitchell & Rupp (1994). For purpose of delineating a definable aquifer as the lowermost USDW, the bottom of the Pennsylvanian Age Linton Formation (Carbondale Group) at a depth of -75 feet MSL [mean sea level] (555 feet BGL [below ground level]) is considered to be the base of the lowermost USDW.

References

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Only reservoirs below the lowermost USDW, within an AOR, are relevant to obtaining a Class I UIC permit. The lowermost USDW within the Edwardsport AOR is estimated at a depth of approximately 470 feet (0 MSL) within the Pennsylvanian Age bedrock by Mitchell & Rupp (1994). For purpose of delineating a definable aquifer as the lowermost USDW, the bottom of the Pennsylvanian Age Linton Formation (Carbondale Group) at a depth of -75 feet MSL [mean sea level] (555 feet BGL [below ground level]) is considered to be the base of the lowermost USDW.

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ATTACHMENT E

DOES NOT APPLY TO CLASS I WELLS

ATTACHMENT F

MAPS AND CROSS-SECTIONS OF GEOLOGIC STRUCTURE OF AREA

F. MAPS AND CROSS-SECTIONS OF GEOLOGIC STRUCTURE OF AREA

In the area of the Edwardsport site, several potential reservoirs meet the criteria for providing a good fluid reservoir. These potential reservoirs include the Cambrian Age Potosi and Mt. Simon Formations, the Ordovician Age Shakopee Dolomite and St. Peter Sandstone and the Ordovician Age Trenton Limestone. One or all of these formations are likely to have favorable reservoir characteristics for injection well operations. These formations are deep enough for effective confinement from the USDW.

Figure F-1 presents a generalized stratigraphic column for the area. Figure F-2 presents the proposed well construction and estimated stratigraphy for WDW #1.

No complex geologic features, such as faults or extensive fracture zones, are known to exist within the AOR. The structural geology in the immediate vicinity of the Edwardsport site is discussed in Section F.1. The region surrounding the site is tectonically stable, and the risk of earthquakes is minimal, as is discussed in Section F.2.

No mineral or petroleum resources of any economic value are expected to be present within the injection or confining zones within the two mile AOR. Depositional environments during the Paleozoic in the region of the site were suitable for the deposition of laterally continuous sedimentary units. After deposition, these units were downwarped and gently tilted, resulting in regional dip to the southwest.

The injection zone, confining zone, and overlying units are laterally continuous, with no abrupt changes in thickness or lithology appears to occur within the area of the Edwardsport site. Section F.4 discusses this in more detail.

Section F.5 discusses the lack of seismic events in the immediate vicinity of the site. Earthquakes which have occurred within 100 miles of Edwardsport have all been orders of magnitude less than the intensity which would be required to damage a well.

The following discussions detail regional and local geology in the vicinity of the Edwardsport site.

F.1 Regional Geologic Structure

Figure F.1-1 illustrates that the Edwardsport site is located in the northeastern portion of the Illinois Basin. The Illinois Basin is bordered on the north by the Wisconsin Arch, and on the west by the Mississippi River Arch and the Ozark Dome. The Pascola Arch forms the southern border of the Illinois Basin, and the basin is bordered on the east and northeast by the Cincinnati Arch and the Kankakee Arch, respectively. The basin covers most of Illinois, and continues southward into Kentucky and southwest Indiana.

The Edwardsport site lies along the southeastern limb of the LaSalle Anticlinal Belt, illustrated in Figure F.1-2. The LaSalle Anticlinal Belt extends from north-central Illinois southeastward into Indiana. Anticlines in the belt are asymmetrical with local dips of up to 1,000 feet per mile on the west flank. On the east flank, the dips are gentle, averaging 100 feet per mile (Clegg, 1965).

Figure F.1-3 shows that the Edwardsport site lies within the Central Granite - Rhyolite Province, immediately to the west of the Wabash Valley Rift.

Treworgy et. al. (1989) indicate that broad and gentle differential downwarp of the Illinois Basin probably began during the late Precambrian. The most rapid subsidence occurred from the latest Precambrian to the late Cambrian. In the central portion of the Illinois Basin, the deposition of a thick blanket of nearshore marine arkosic sandstone resulted from the rapid subsidence. The tectonic subsidence is thought to be related to rifting, thermal subsidence, and an isostatically uncompensated mass in the lower crust.

The Kankakee Arch developed in early Ordovician time, separating the Illinois Basin from the Michigan Basin. In late Paleozoic time, compressive stresses acting on the Appalachians and Ouachitas were responsible for tectonic events occurring in the basin. During the Cenozoic, the surface of Indiana was finally altered to its present form by erosion and deposition associated with continental ice sheets. Seven major unconformities are recognized in southwestern Indiana. These unconformities were the result of widespread transgression and regression of the seas, erosion and tectonic events (Willman et. al., 1975). Several minor unconformities are recognized and are the result of subaerial processes.

Figure F.1-4 illustrates the major faults and some anticlinal belts in the Illinois Basin. The Wabash River Valley fault system contains the only known faults within 100 miles of the Edwardsport site. The Wabash Valley System is comprised of high angle normal faults.

Displacements of this fault system have been reported to be several hundred feet (Nelson and Lumm, 1984).

F.2 Regional Stratigraphy

The sedimentary rocks underlying the Edwardsport site are comprised mainly of marine sediments deposited during the Paleozoic Era. These consolidated bedrock units are comprised of dolomite, limestone, sandstone, siltstone, and shales and are of Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, Cambrian, and Precambrian Ages. Approximately 50 feet of glacial alluvium overlies the consolidated rocks. Most geologic units underlying the Edwardsport site dip approximately 100 feet per mile toward the southwest into the center of the Illinois Basin.

Most geologic information is interpreted from driller's descriptions and geophysical logs run on exploration wells previously drilled in the area. In Indiana, only 24 wells have penetrated through the entire sequence of sedimentary rocks to the underlying Precambrian basement, and all but three of these wells lie along the Cincinnati and Kankakee Arches, where the depth to the basement is less than 4,600 feet. Data for the deeper rock units is therefore derived from extrapolation of geologic data from these few available test wells and on interpretation of geophysical data obtained from gravity, magnetic, electrical, and seismic surveys.

For the area of the Edwardsport site, the estimated formation tops and thicknesses are provided in Table F.2-1 which was created from limited available geologic data, thus chosen formation thicknesses and formation tops should be considered preliminary. The stratigraphic nomenclature used was obtained from Shaver and others (1986).

TABLE F.2-1
Estimated Formation Tops and Thickness

Group	Formation	Depth (BGL)*	Depth (MSL)**	Thickness	Age
	Alluvium	0'	+480'	50'	Q
McLeansboro	Shellburn Fmn	50'	+430'	90'	P
Carbondale	Dugger Fmn	140'	+340'	90'	P
	Petersburg Fmn	230'	+250'	175'	P
	Linton Fmn	405'	+75'	150'	P
Raccoon Creek	Staunton Fmn	555'	-75'	125'	P
	Brazil Fmn	680'	-200'	75'	P
	Mansfield Fmn	755'	-275'	255'	P
Buffalo Wallow	Absent	----	----	----	M
Stephensport	Glen Dean Ls	1010'	-530'	10'	M
	Hardinsburg Fmn	1020'	-540'	65'	M
	Haney Ls	1085'	-605'	10'	M
	Big Clifty Fmn	1095'	-615'	35'	M
	Beech Creek Ls	1130'	-650'	10'	M
West Baden	Cypress Fmn	1140'	-660'	60'	M
	Reelsville Ls	1200'	-720'	5'	M
	Sample Fmn	1205'	-725'	35'	M
	Beaver Bend Ls	1240'	-760'	10'	M
	Bethel Fmn	1250'	-770'	30'	M
Blue River	Paoli Ls	1280'	-800'	50'	M
	Ste. Genevieve Ls	1330'	-850'	125'	M
	St. Louis Ls	1455'	-975'	325'	M
Sanders	Salem Ls	1780'	-1300'	175'	M
	Harrodsburg Ls	1955'	-1475'	125'	M

TABLE F.2-1 (continued)

Group	Formation	Depth (BGL)*	Depth (MSL)**	Thickness	Age
	Muldraugh Fmn	2080'	-1600'	300'	M
Borden	Edwardsville Fmn	2380'	-1900'	75'	M
	Spickert Knob Fmn	Absent	----	----	M
	New Providence Sh	2455'	-1975'	75'	M
	New Albany Sh	2530'	-2050'	150'	M/D
Muscatatuck	North Vernon Ls	2680'	-2200'	100'	D
	Jeffersonville Ls	2780'	-2300'	100'	D
New Harmony	Backbone Ls	2880'	-2400'	250'	D
Bainbridge	Bailey Ls	3130'	-2650'	100'	D
	Mocassin Springs Fmn	3230'	-2750'	300'	D
	St. Claire Ls or Salmonie Dol	3530'	-3050'	50'	S
	Sexton Creek Ls	3580'	-3100'	50'	S
Maquoketa	Brainard Sh	3630'	-3150'	120'	O
	Fort Atkinson Ls	3750'	-3270'	30'	O
	Scales Sh	3780'	-3300'	150'	O
Trenton	Trenton Ls	3930'	-3450'	125'	O
Black River	Plattin Fmn	4055'	-3575'	250'	O
	Pecatonica Fmn	4305'	-3825'	75'	O
Ancell	Joachim Dol	4380'	-3900'	150'	O
	Dutchtown Fmn	4530'	-4050'	100'	O
	St. Peter Ss	4630'	-4150'	50'	O
Knox Prairie duChien	Shakopee Dol	4680'	-4200'	800'	O

TABLE F.2-1 (contiued)

Group	Formation	Depth (BGL)*	Depth (MSL)**	Thickness	Age
Knox Prairie duChien	Oneata Dol	5480'	-5000'	400'	O
Knox Prairie duChien	Potosi Dol	5880'	-5400'	1400'	C
Potsdam Munising	Eau Claire Fmn	7280'	-6800'	1000'	C
Potsdam Munising	Mt. Simon Ss	8280'	-7800'	1200'	C
	PreCambrian	9480'	-9000'	----	PC

Geologic Time Periods

Q = Quaternary
P = Pennsylvanian
M = Mississippian
D = Devonian
S = Silurian
O = Ordovician
C = Cambrian
PC = PreCambrian

* BGL = Below Ground Level
** MSL = Mean Sea Level

F.2.1 Precambrian Basement

The basement complex in most of Illinois and Indiana, including the vicinity of the Edwardsport site, has been identified as being part of the Central Granite-Rhyolite Province. The general lithology of the Central Granite-Rhyolite Province is an anorogenic granitic or felsic intrusive terrain. The Precambrian basement is thought to occur at approximately 9,500 feet, and to be comprised of granite or rhyolite in the vicinity of the Edwardsport site.

F.2.2 The Cambrian System

The Cambrian System is found throughout the Illinois Basin. It is comprised, in descending order, of the Potosi Dolomite, the Munising Group, and the Mt. Simon Sandstone. The Munising is divided into the Davis Formation and the Eau Claire Formation. Sandstones are a dominant lithology of the system, with dolomites becoming more prevalent in the upper part of the system. Figure F.2.2-1 shows that rocks of the Cambrian System in Indiana range from less than 1,500 feet to more than 4,000 feet in thickness.

Together, the Munising and the Mt. Simon comprise the Potsdam Supergroup (Droste and Patton, 1985). Figure F.2.2-2 illustrates that the Potsdam ranges in thickness from less than 1,000 feet in eastern Indiana to more than 3,000 feet in northwestern Indiana. The Mt. Simon Sandstone is composed predominantly of immature quartz sandstones within thin zones of interbedded siltstones and shales (Becker and others, 1978). In northwestern Indiana, the Munising is comprised of the Eau Claire, Galesville, Ironton, and Franconia Formations. Figure F.2.2-3 shows that the Galesville, the Ironton, and the Franconia are identified only in northwestern Indiana, and these three units grade eastward and southward into the siltstone, shale, limestone, and dolomite of the Davis Formation (Droste and Patton, 1985). In southwestern Indiana there is a complete lack of well data, and it is not known if the Davis is present (Becker and others, 1978). Becker and others (1978) have suggested that in southern Indiana the Davis Formation may be absent and the Knox Supergroup may directly overlie carbonate rocks of the Eau Claire Formation.

The Cambrian Age Potosi Dolomite is considered to be the lowest member of the Knox Supergroup. The strata that constitute the Potosi Dolomite and the Eminence Formation of Illinois are traced as a single unit, the Potosi Dolomite, throughout Indiana. Figure F.2.2-4 indicates that the Potosi Dolomite thickens southward with a distinctive increase in rate from central Indiana southward. Droste and Patton (1985) state that the southerly increase results in part from the downstepping of the Potosi throughout the Franconia, Ironton, and Galesville stratigraphic intervals to the place where the Potosi lies on the Eau Claire Formation.

F.2.3 The Ordovician System

The Ordovician System in southwestern Indiana is comprised of the Prairie du Chien Group, the Ancell Group, the Black River Group, and the Trenton Limestone. The individual group units consist of dolomites, limestones, sandstones, and shales. The Prairie du Chien Group consists of the Oneata and the Shakopee Dolomites. The Ancell Group consists of the

Joachim Dolomite, the Dutchtown Formation and the St. Peter Sandstone. The Black River Group consists of the Plattin and Pecatonica Formations.

The Oneata Formation of the Prairie du Chien Group is recognized throughout most of Indiana, although it has been removed by pre-Middle Ordovician erosion in far northwestern Indiana. Figure F.2.3-1 shows that the unit is thought to range from 400 to 500 feet in thickness in southwestern Indiana. The Oneata consists predominantly of dolostone, contains modest amounts of sporadic quartz sand, and contains thin greenish shale beds, particularly near its base (Droste and Patton, 1985). The top of the Oneata is transitional into the overlying Shakopee Dolomite.

The Shakopee Dolomite is a member of the Prairie du Chien Formation. Figure F.2.3-2 illustrates that the thickness of the Shakopee Dolomite in Indiana ranges from 0 feet in the northern part of the state to an estimated 1,200 feet in the southwestern corner of Indiana. The Shakopee Dolomite is pure to impure and very fine-grained to fine-grained dolostone with interbeds of shale, siltstone, and sandstone. Sandstone beds generally as much as several tens of feet thick are present in southeastern Indiana. The Shakopee of Illinois also contains sandstones (Willman and Buschbach, 1975).

The Ancell Group ranges from 0 to more than 450 feet in thickness in Indiana, as illustrated in Figure F.2.3-3. Droste and others (1982) state that it lies with significant unconformity on either the Knox Dolomite or the Everton Dolomite below, and is overlain by the Black River Group with sharp contact probably representing a minor erosional discontinuity. The lowermost member of the Ancell Group is the St. Peter Sandstone. The St. Peter ranges in thickness from 0 feet to over 170 feet in Indiana (Figure F.2.3-4). Sharp differences in thickness over a few tens of miles have been observed and are thought to result from moderate relief developed along the unconformity on the subjacent Knox rocks before St. Peter deposition and because of facies changes from St. Peter rocks to Dutchtown or Joachim rocks within short distances (Droste and others, 1982). Abruptly increased thickening (as much as 200 additional feet is observed in some wells in northwestern Indiana) over short distances within the continuous body of the St. Peter is also known. Sinkholes, karst-solution valleys, or similar box-canyon features developed on the Knox erosion surface could be the reason for the abrupt thickening.

Generally, the St. Peter is composed of fine to medium well-rounded and well-sorted frosted grains of quartz that are weakly cemented. In some places, secondary quartz overgrowths and siliceous intergranular cement produce well-indurated rather than friable sandstone. In southern Indiana, the St. Peter may have carbonate cement and thin interbeds of carbonate rock, generally dolomite (Droste and others, 1982).

The Dutchtown Formation within the Ancell Group has a transitional contact with the St. Peter in the area where the Dutchtown is present. Figure F.2.3-5 indicates the thickness and distribution of the Dutchtown in Indiana. The Dutchtown Formation in Indiana correlates with the Wells Creek Formation in Ohio. The Dutchtown is comprised of light-gray and brown partly argillaceous dolomite with some thin interbeds of green shale. In areas where the unit shows a transitional boundary with the St. Peter Sandstone, dolomite cemented medium-grained sandstone is present.

The Joachim Dolomite has the greatest subsurface distribution of the three formations of the Ancell Group (Figure F.2.3-6). The Joachim is thought to have a thickness of greater than 150 feet in southwestern Indiana. The Joachim consists of varicolored limestone and dolomite. The upper portion of the Joachim, ranging from 0 to 80 feet in thickness, contains light-colored to dark, silty to very argillaceous, and very fine-grained to fine-grained dolomite and limestone with interbedded greenish to dark-gray to black shales. Thin beds of bimodal sandstone are also present.

The Black River Group in Indiana ranges from just less than 100 feet to more than 520 feet. Figure F.2.3-7 illustrates the thickness and distribution of the Black River Group in Indiana. Where formations of the Ancell Group are present, the Pecatonica Formation of the Black River Group overlies the Ancell with minor erosional discontinuity. The Pecatonica ranges from 30 to nearly 130 feet in thickness. Figure F.2.3-8 illustrates the thickness and distribution of the Pecatonica. In most of Indiana, the Pecatonica is comprised of grayish-brown to dark-brownish-gray lithographic limestones and fine-grained burrow-mottled limestones and dolomites. Throughout most of Indiana, a dark argillaceous limestone or silty calcareous shale zone a few feet thick is near the base of the Pecatonica.

The Plattin Formation of the Black River Group ranges from less than 100 feet to more than 400 feet in thickness in Indiana. Figure F.2.3-9 shows a gradual thickening from northwestern to southeastern Indiana, and a distinct increased thickening into southwestern Indiana. The Plattin is comprised of lithographic limestone. Beds of K-bentonite may be present.

The Plattin is overlain in Indiana by the more coarsely bioclastic carbonate rocks of the Trenton Limestone, except in parts of southeastern Indiana where rocks of the Maquoketa Group or the Lexington Limestone lie above. The Trenton has a maximum thickness of 265 feet in northeastern Indiana, and it thins to zero thickness in far southeastern Indiana (Shaver and other, 1986). Figure F.2.3-10 shows the thickness of the Trenton to be between 100 and 200 feet throughout most of central and southwestern Indiana.

The Trenton is overlain by formations of the Ordovician Age Maquoketa Group. Figure F.2.3-11 illustrates the thickness and distribution of the Maquoketa Group in Indiana. In western Indiana, the Maquoketa Group is comprised of the Scales Shale, the Fort Atkinson Limestone, and the Brainard Shale. Shaver and others (1986) believe that the contact between the Trenton and the overlying Scales Shale is a regionally time-transgressive discontinuity. The Scales Shale is commonly about 150 feet thick in western Indiana, but it thickens strikingly eastward and southeastward. The upper part is gray shale containing thin beds of limestone that become more abundant southeastward. The lower part is dominantly dark brown shale. Figure F.2.3-12 illustrates the thickness and lithofacies interpretations of the Scales Shale and its stratigraphic equivalents in Indiana.

The Fort Atkinson Limestone of the Maquoketa Group overlies the Scales Shale. The Fort Atkinson is present in the northern, central, and western portions of Indiana, and is approximately 50 feet thick over most of this area. It includes light-colored, coarsely crystalline limestone and dolomite, mainly in its upper part, and gray argillaceous limestone and calcareous shale, mainly in its lower part.

The Brainard Shale is thought to conformably overlie the Fort Atkinson Limestone in northern, central, and southwestern Indiana (Shaver and others, 1986). Over most of its area of recognition, the Brainard is 75 to 150 feet thick. The Brainard consists primarily of gray to greenish-gray shale that contains a few thin interbeds of limestone. It is overlain in central and western Indiana by the Silurian Age Brassfield Limestone or Sexton Creek Limestone. Figure F.2.3-13 illustrates the structural configuration on top of the Maquoketa Group in Indiana.

F.2.4 The Silurian System

Over most of Indiana, rocks that unconformably overlie the Maquoketa Group are assigned to the Silurian Age Brassfield Limestone. This ranges in lithology from light-colored calcarenite in southeastern Indiana to cherty limestone to shaly limestone in southwestern Indiana. The Sexton Creek Limestone is a distinctive facies of the Brassfield present in the western half to two-thirds of Indiana. The Sexton Creek averages between 40 and 50 feet in thickness (Shaver and others, 1986).

The Sexton Creek is overlain unconformably by the St. Claire Limestone in southwestern Indiana and by the Salmonie Dolomite elsewhere in the state. In southwestern Indiana, the Salmonie has a vertical cutoff boundary with the approximate lower half of the St. Claire Limestone. The Salmonie rocks are generally impure, and include finer grained argillaceous limestone and dolomite limestone and shale. The St. Claire ranges from 30 to 90 feet in thickness and averages about 60 feet in thickness in the subsurface of southwestern Indiana. The St. Claire's upper contact with the Moccasin Springs Formation generally involves an upward transition through several feet of interbedded pure limestones and argillaceous limestones (Shaver and others, 1986).

The Moccasin Springs Formation consists mostly of dense to fine-grained, somewhat argillaceous limestones that are interbedded as variably colored units. In most places, the top 20 feet of the formation consists of dark-gray to black dolomitic shale interbedded with dark-greenish-gray very fine-grained argillaceous limestone. Dark red carbonate rocks are particularly characteristic of the lower part of the formation. The Moccasin Springs has a reef facies consisting of relatively pure carbonate rocks partly in reefs that appear to have begun growth during early Moccasin Springs deposition, and partly in reefs that continued growth upward from the St. Claire Limestone. Pinnacle reefs, isolated reef growths that stand several hundred feet high and that generally cover less than one square mile, have been observed in the adjacent Sullivan and Vigo Counties. Figure F.2.4-1 is an isopach map of the Silurian System in Indiana, not including the Bailey Limestone. Figure F.2.4-1 also indicates the locations of known reefs in southwestern Indiana. The non-reef Moccasin Springs in Indiana ranges from 60 to 140 feet in thickness.

The Moccasin Springs Formation is conformably overlain by the Bailey Limestone. The contact is placed between the darker and impurer carbonate rocks below and lighter and more neutrally colored and purer carbonate rocks above. The Bailey consists of drab, neutrally colored limestones and some dark-gray limestone. They are mostly very fine-grained, somewhat cherty, and slightly dolomitic. The Bailey has a reef and bank facies. It is believed that the Bailey reef rocks are upward continuations of reefs that began to grow in the underlying St. Claire and Mocassin Springs Formations. The Bailey's non-reef thickness is as much as 375 feet in Indiana. Figure F.2.4-2 illustrates the combined thickness of the Mocassin Springs Formation and the Bailey Limestone within the Illinois Basin.

F.2.5 The Devonian System

Within the Illinois Basin, the Silurian Age Bailey Limestone is overlain by the New Harmony Group of the lower Devonian. Overlying Devonian Groups include the Muscatatuck Group and the New Albany Shale.

South of the Kankakee and Cincinnati Arches, the New Harmony Group is comprised of the Backbone Limestone, the Grassy Knob Chert, and the Clear Creek Chert. Within Indiana, the Grassy Knob Chert is only present in the extreme southwestern portion of Posey County. The Clear Creek Chert does not extend into the northern portion of Knox County. Figure F.2.5-1 illustrates the thickness and distribution of the Backbone Limestone in the Illinois Basin. In its approximately 10-county area of distribution in subsurface southwestern Indiana, the Backbone thickens southwestward from an erosional zero to a north-south elongate area of maximum thickness in the westernmost counties south of Vigo County (Shaver and others, 1986). The Backbone also thickens southward along this area, so that the thickest deposits may reach 600 feet in Posey County. Westward from this area thinning occurs basinward, probably because of a complementary relationship with the Clear Creek Chert. The Backbone is comprised of light-colored medium to coarse-grained, rather pure bioclastic limestone. The Backbone has two prominent intervals of drab cherty dolomitic limestone and dolomitic chert.

South of the Kankakee and Cincinnati Arches, the Muscatatuck Group is comprised of the Jeffersonville Limestone and the North Vernon Limestone. The Jeffersonville consists of the Dutch Creek Sandstone, Geneva Dolomite, and Vernon Fork Members. Figure F.2.5-2 illustrates the thickness and distribution of the Jeffersonville Limestone. A thin bentonite bed, named the Tioga bentonite bed, acts as a marker for the upper portion of the Jeffersonville in southwestern Indiana, including Knox County. The Jeffersonville consists of fossiliferous limestone. The Dutch Creek Member consists of hard sandy limestone, with sand more abundant at the base of the unit. Where present, the Geneva Dolomite Member consists of brown and tan fine to medium-grained, somewhat massive, finely vuggy dolomite. Figure F.2.5-3 illustrates the thickness and distribution of the Geneva Dolomite. The Geneva is not thought to be present in Knox County. The Vernon Fork Dolomite in western Indiana is fine to medium-grained, finely vuggy, and mostly brown. Figure F.2.5-4 illustrates the thickness and distribution of the North Vernon Limestone.

The New Albany Shale conformably overlies the Muscatatuck Group in southwestern Indiana. The New Albany Shale has been divided into five members, which in ascending order are: Blocher; Selmier; Morgan Trail; Camp Run; and Clegg Creek. The uppermost member of the

New Albany Shale (Clegg Creek Member) is considered to be Mississippian in age. On the whole, the New Albany has been described as brownish-black carbon-rich shale, greenish-gray shale, and minor amounts of dolomite and dolomitic quartz sandstone (Shaver and others, 1986). Figure F.2.5-5 illustrates the thickness and distribution of the New Albany Shale in Indiana. The New Albany Shale is approximately 150 feet thick in northern Knox County. Figure F.2.5-6 is a map showing the structure on the base of the New Albany Shale.

F.2.6 The Mississippian System

The Mississippian System is comprised, in ascending order, of the Clegg Creek Member of the New Albany Shale, the Borden Group, the Sanders Group, the Blue River Group, the West Baden Group, the Stephensport Group, and the Buffalo Wallow Group. The Mississippian rocks are divisible into three lithologically distinct parts. The upper part, which comprises repeated cyclic sequences of sandstone, shale, and limestone and the middle part, which consists principally of limestone of many textural varieties, are restricted to southwestern Indiana. The lower part, a clastic sequence of siltstone and shale, is present in both northern and southwestern Indiana. (Gray, 1979). Figure F.2.6-1 illustrates the distribution of both Mississippian and Pennsylvanian rocks in Indiana.

Overlying the Mississippian Age Clegg Creek Member of the New Albany Shale is the Borden Group. The Borden Group is comprised of the New Providence Shale, the Spickert Knob Formation, and the Edwardsville Formation. The Borden Group is a clastic wedge composed primarily of calcareous siltstone and shale and includes subordinate amounts of fine-grained sandstone and dolomitic limestone (Rupp, 1991). Figure F.2.6-2 illustrates the thickness and distribution of the Borden Group in Indiana. The Borden Group is thought to be approximately 200 to 300 feet thick in Knox County.

The Sanders Group conformably overlies the Borden Group in most of southwestern Indiana. The Sanders Group is comprised of the Muldraugh Formation, the Harrodsburg Limestone, and the Salem Limestone. The Sanders Group is composed primarily of carbonate rocks. The Muldraugh Formation at the base of the group is dominantly a mixture of fine-grained dolomite and limestone with minor amounts of siltstone and shale. The overlying Harrodsburg Limestone is comprised of argillaceous limestone, dolosiltites, and shale. The Salem Limestone, except for the Somerset Shale Member at its base, is dominated by porous calcarenite, although it contains a wide variety of other kinds of limestone (Shaver and others, 1986). Oil is produced from the porous zones in the Salem Calcarenite (Keller and Becker, 1980). Figure F.2.6-3 illustrates the thickness and distribution of the Sanders Group in Indiana. Figure F.2.6-4 illustrates the structure on top of the Salem Limestone in southwestern Indiana.

The Blue River Group conformably overlies the Sanders Group. The three component formations of the Blue River Group, in ascending order, are the St. Louis, Ste. Genevieve, and Paoli Limestones. The Blue River Group is formed largely of carbonate rocks, but has significant amounts of gypsum, anhydrite, shale, chert, and calcareous sandstone (Shaver and others, 1986). Figure F.2.6-5 illustrates that the thickness of the Blue River Group varies from 450 feet in northeastern Knox County to 650 feet in southwestern Knox County. The St. Louis Limestone of the Blue River Group contains a moderate variation of interbedded carbonate rocks, a modest number of drab thin shale beds, and in some areas zones of gypsum and anhydrite layers (Droste and Carpenter, 1990). The Ste. Genevieve Limestone is divided into three members, in ascending order, the Fredonia Member, the Karnak Member, and the Joppa Member. The Ste. Genevieve Limestone is a carbonate sequence composed largely of oolitic, skeletal, micritic, and detrital limestone. Shale, dolomite, sandstone, and chert compose about 10 percent of the combined Paoli and Ste. Genevieve Limestones (Shaver and others, 1986). The component members of the Paoli Limestone are, in ascending order, the Aux Vases Member, the Renault Member, the Yankeetown Member, and the Downeys Bluff Member. In general, the Paoli Limestone is an assortment of lighter colored carbonate rocks ranging from grainstone to mudstone with lesser amounts of interbedded shale and sandstone.

The Blue River Group is conformably overlain by the West Baden Group in southwestern Indiana. The West Baden Group consists in ascending order, of the Bethel Formation, the Beaver Bend Limestone, the Sample Formation, the Reelsville Limestone, and the Cypress Formation. The Group consists dominantly of gray to varicolored shale and mudstone and thin-bedded to crossbedded sandstone; limestone in beds of variable thickness is an important but lesser constituent (Shaver and others, 1986). Figure F.2.6-6 illustrates that the thickness of the West Baden Group in Knox County varies between 60 and 180 feet. Much of the irregular thickness distribution of the group is caused by large clastic-filled channels that thicken and replace underlying parts of the group and the top of the carbonate rocks of the underlying Blue River Group (Rupp, 1991).

The West Baden Group is conformably overlain by the Stephensport Group in southwestern Indiana. The Stephensport consists, in ascending order, of the Beech Creek Limestone, Big Clifty Formation, Haney Limestone, Hardinsburg Formation, and the Glen Dean Limestone. Lithologically, the units range in composition from clean shale to poorly sorted argillaceous siltstone and fine to medium-grained sandstone. Limestone within the group is predominantly coarse-grained clean bioclastic grainstones. Some formations of the Stephensport Group are thin or absent in much of Knox County. Figure F.2.6-7 illustrates the thickness and distribution of the Stephensport Group in Indiana.

Where present, the Buffalo Wallow Group conformably overlies the Stephensport Group. In the subsurface, the Group is divided stratigraphically into nine units. In ascending order, these are the Tar Springs Formation, the Vienna Limestone, the Waltersburg Sandstone, the Menar Limestone, the Palestine Sandstone, the Clore Limestone, the Degonia Sandstone, the Kinkaid Limestone, and the Grove Church Shale. Buffalo Wallow rocks include predominantly shale, siltstone, and sandstone with subordinate amounts of limestone. The Buffalo Wallow is unconformably overlain throughout the basin by rocks of Pennsylvanian Age. As a result, there is progressive truncation of older rocks toward the basin margin. Figure F.2.6-8 illustrates the subcrop limit of the Buffalo Wallow Group. As can be seen from this figure, the Buffalo Wallow is absent from much of Knox County, Indiana.

F.2.7 The Pennsylvanian System

The Pennsylvanian System is comprised of the Raccoon Creek, Carbondale, and McLeansboro Groups. Pennsylvanian rocks are present only in western and southwestern Indiana (Figure F.2.7-1). The division separating the Mississippian and older rocks from those of the Pennsylvanian is marked by a substantial unconformity throughout most of western and southwestern Indiana. Figure F.2.7-2 illustrates the structure on the base of the Pennsylvanian System. The unconformity has the aspect of a southwest-sloping plateau entrenched as much as 300 feet by integrated systems of southwest-trending consequent stream valleys (Gray, 1979). Because of local relief on the unconformity, Pennsylvanian rocks in any given area may rest on several older formations, but a regional trend also exists because the older rocks were slightly tilted and erosionally beveled before deposition of basal Pennsylvanian sediments. As a result, Pennsylvanian rocks rest on youngest Mississippian rocks at the southern extremity of the outcrop area and on progressively older rocks northward.

Although the Pennsylvanian System of Indiana is stratigraphically divided into three groups (Raccoon Creek, Carbondale, and McLeansboro), Rupp (1991) divided the system approximately in half for convenience of description by using the top of the Springfield Coal Member (Coal V) of the Petersburg Formation (Carbondale Group) as the plane of division. Units that compose the lower half of the system include the Mansfield, Brazil, and Staunton Formations of the Raccoon Creek Group and the Linton and Petersburg Formations of the Carbondale Group. The units are composed of alternating sequences of terrigenous to proximal marine deposits of conglomerate, sandstone, siltstone, shale, and coal, and subordinate amounts of thin limestone. Figure F.2.7-3 illustrates the structure on top of the Springfield Coal Member of the Petersburg Formation in Indiana. Figure F.2.7-4 illustrates the thickness of the lower part of the Pennsylvanian System.

The upper part of the Pennsylvanian System conformably overlies the Springfield Coal. The Dugger Formation of the Carbondale and the Shelburn, Patoka, Bond, and Mattoon Formations of the McLeansboro comprise the upper part of the Pennsylvanian System. Figure F.2.7-5 illustrates the entire columnar section showing the nature and formation names of Pennsylvanian rocks in Indiana.

Because of extensive glaciation by Pleistocene continental ice sheets and sediment dispersal in subsequent interglacial episodes, much of the bedrock surface in Indiana has been differentially eroded. Only a small area in south central Indiana has not been directly affected by the glacial ice. Sediments representing Mesozoic and early Cenozoic time are not present in Indiana either because of non-deposition or because of complete erosional removal. As a result of this erosion, the Bond and Patoka Members of the McLeansboro Group are thought to be absent in the vicinity of Scepter.

F.2.8 Pleistocene

The northern and central parts of Indiana are mantled by Pleistocene deposits of glacial and interglacial origin. These clastic sediments are primarily unconsolidated silt, sand, and gravel that are moderately to poorly sorted. Some clay-rich sediments occur as tills and lacustrine and glacial meltwater deposits. Most of the northern deposits are ice-contact sediments, but the more southerly deposits are primarily outwash or meltwater sediments.

F.3 Local Geology

The following text provides local geologic information for the area surrounding the Edwardsport site. The information in this section is inferred from published sources containing regional information, and from well drilling records for oil and gas wells drilled in the vicinity. Inferences made by Subsurface and made in published works using data derived from these wells were used to establish likely depths to formation tops in the vicinity of the Edwardsport site. Considerable interpolation was required between the sparse well data for all geologic units. It should be noted that these formation tops are estimated with an accuracy not greater than 100 feet.

The local continuity of injection and confining intervals can also be demonstrated by regional structure and isopach maps. The structure maps for this area indicate no faulting in the Edwardsport site vicinity, and the isopach maps for this area indicate only regional thickening and thinning of the injection and confining zones.

Figure F.3-1 illustrates structure on top of the Mt. Simon Formation in Indiana - a potential injection zone. Figure F.3-1 shows only a regionally dipping surface in southwestern Indiana. Figure F.3-2 illustrates that the Mt. Simon thins to the south and to the west. The Mt. Simon reaches a maximum thickness of 2,000 feet in northwestern Illinois. The Mt. Simon is thought to be approximately 1,200 feet thick and to occur at a depth of approximately 7,800 feet MSL (8,280 feet BGL) in the vicinity of the Edwardsport site.

The Eau Claire Formation, comprised of shale, dolomite, and limestone would act as confinement for a Mt. Simon injection zone. Figure F.3-3 illustrates that the Eau Claire thickens from approximately 500 feet in the northeastern portion of Indiana to more than 1,000 feet in southwestern Indiana. The Eau Claire is thought to be approximately 1,000 feet thick at the Edwardsport site, and to occur at an approximate depth of 6,800 feet MSL (7,280 feet BGL).

The Potosi Dolomite could act as a potential injection zone or could provide additional confinement for a Mt. Simon reservoir. The Potosi is thought to be approximately 1,400 feet thick in the vicinity of the Edwardsport site. At the Edwardsport site, the Potosi is thought to occur at an approximate depth of 5,400 feet MSL (5,880 feet BGL).

The overlying Oneata Dolomite would provide confinement to a Potosi or Mt. Simon reservoir. The Oneata is thought to be approximately 400 feet thick in the vicinity of the site, and to occur at an approximate depth of 5,000 feet MSL (5,480 feet BGL).

The Shakopee Dolomite in conjunction with the overlying St. Peter Sandstone is a potential injection interval. The Knox unconformity occurs in between the Shakopee and the St. Peter. Natural fractures and higher porosity rock often occur at the interface between unconformable rocks. The presence of the major erosional unconformity at the top of the Knox Group is likely to provide a zone of good porosity and permeability. Figure F.3-4 illustrates the structure on top of the Shakopee Dolomite (top of the Knox Supergroup). The Shakopee Dolomite is comprised of fine-grained dolostone with interbeds of shale, siltstone, and sandstone. Although sandstone beds are prominent at the top of the Shakopee in some portions of Indiana, they are not known to be present in the vicinity of the Edwardsport site. The Shakopee is thought to be approximately 800 feet thick at the site, and to occur at an approximate depth of 4,200 feet MSL (4,680 feet BGL).

The St. Peter Sandstone Member of the Ancell Group is thought to be a potential injection zone and is comprised of well-rounded and well-sorted quartz grains that are weakly cemented. In southern Indiana, the St. Peter may have carbonate cement and thin interbeds of carbonate rock, generally dolomite. Great increases in thickness of the St. Peter over a small distance are known to occur in northwestern Indiana. Insufficient data exists to infer whether such irregularities in thickness may occur in southwestern Indiana. It is thought that the irregularities may occur due to the presence of erosional features on top of the Knox unconformity. The St. Peter is thought to be approximately 50 feet thick in the vicinity of the Edwardsport site. It is thought to occur at an approximate depth of 4,150 feet MSL (4,630 feet BGL).

The Dutchtown Formation and the Joachim Dolomite of the Ancell Group would provide immediate confinement above the Shakopee/St.Peter injection zone. Both the Dutchtown and the Joachim are composed of argillaceous dolomite. The Dutchtown contains some thin beds of green shale. The thickness of the Dutchtown Formation is expected to be approximately 100 feet, and the thickness of the Joachim Dolomite is expected to be approximately 150 feet in the vicinity of the site. These units are expected to be found at depths of 4,050 feet MSL (4,530 feet BGL) and 3,900 feet MSL (4,380 feet BGL) respectively.

The Pecatonica and Plattin Formations of the Black River Group would also act as confinement to a Shakopee/St. Peter reservoir. In southwestern Indiana, the Pecatonica is comprised of lithographic and burrow-mottled limestones. Figure F.3-5 illustrates that the Pecatonica is expected to be approximately 75 feet thick. The Pecatonica is expected to occur at an approximate depth of 3,825 feet MSL (4,305 feet BGL) in the vicinity of Scepter. The Plattin Formation is comprised of lithographic carbonates and may contain bentonite beds. The Plattin is expected to be approximately 250 feet thick and to occur at a depth of approximately 3,575 feet MSL (4,055 feet BGL).

The Trenton Limestone is another potential injection interval. A major erosional unconformity exists at the top of the Trenton that may have enhanced the porosity and permeability of the upper Trenton. Four different types of reservoirs occur in the Trenton throughout the eastern United States (Zuppman and Keith, 1988). These four types of reservoirs are: 1) those with limestone-matrix porosity; 2) those with tectonically controlled fractures with no matrix porosity; 3) those associated with regional dolomitization; and 4) those associated with localized dolomitization and solution along linear structural features. The first two types of reservoirs are not associated with Black River rocks. In southern Illinois, the first type of reservoir exists as the Trenton contains proven oil reservoirs where intergranular porosity has been preserved in grainstone lenses. Insufficient data exists to determine whether conditions conducive to reservoir formation may exist in the Trenton rocks beneath the Edwardsport site. The Trenton varies compositionally from tan to medium tannish-gray grainstone to wackestone, and becomes progressively more dolomitic toward northern Indiana. Figure F.3-6 illustrates the structure on top of the Trenton Limestone in Indiana. The Trenton is expected to be approximately 125 feet thick in the vicinity of the Edwardsport site, and to be located at an approximate depth of 3,450 feet MSL (3,930 feet BGL).

Confinement for a Trenton injection reservoir would be provided by the Scales Shale, Fort Atkinson Limestone, and Brainard Shale of the Ordovician Age Maquoketa Group. The Maquoketa Group is composed predominantly of gray shale with subordinate limestone interbeds. In southwest Indiana, the Maquoketa consists almost entirely of shale. The entire Maquoketa Group is thought to be approximately 300 feet thick in the vicinity of the site, and to be located at an approximate depth of 3,150 feet MSL (3,630 feet BGL).

The Silurian Age Sexton Creek Limestone would provide additional confinement for a Trenton injection zone. The Sexton Creek is described as gray limestone interbedded with chert (Becker, 1974). The Sexton Creek is thought to be approximately 50 feet thick in the vicinity of the site.

Possible Silurian reef structures located in the overlying Bainbridge Group may provide another possible injection zone. Reef structures are often porous and permeable and could provide excellent injectivity. The Bainbridge Group is comprised of the St. Claire Limestone, the Mocassin Springs Formation, and the Bailey Limestone. The Edwardsport site is located near the southwestern edge of the area in which reefs structures are thought to occur in the formations of the Bainbridge. Figure F.3-7 illustrates the structure on top of the Salamonie Dolomite. Figure F.3-7 also shows that the Edwardsport site is located very close to the boundary at which the Salamonie Dolomite is no longer recognized because of facies relationship with the St. Claire Limestone. Most recognized large reefs within Indiana occur in the Silurian section above the Salamonie Dolomite. The proximity of the Edwardsport site to the southwestern boundary of the presence of the Salamonie, and the presence of known reef structures, makes it very difficult to predict the likelihood that a well developed reef structure would be intersected by an Edwardsport injection well. This is especially true of prediction of the presence of a pinnacle reef structure which would have a breadth of a mile or two at most.

The St. Claire Limestone (or Salamonie Dolomite) is thought to have a thickness of approximately 50 feet in the vicinity of the Edwardsport site. The overlying Mocassin Springs

Formation should have a depth of approximately 300 feet if moderate reef development has occurred. The overlying Bailey Limestone is thought to be approximately 100 feet thick in the vicinity of the site. The entire Bainbridge Group may be as much as 200 feet thicker if pinnacle reef development has occurred. Alternately, the Bainbridge Group may be as much as 200 feet thinner than predicted if no reef structure is present in the Mocassin Springs Formation. The top of the Bainbridge Group in the vicinity of the site is thought to occur at an approximate depth of 2,650 feet MSL (3,130 feet BGL).

The Devonian Age Backbone Limestone of the New Harmony Group would provide confinement for a Bainbridge injection zone. Alternately, the Backbone may be utilized in conjunction with the Bainbridge as an injection reservoir. Rupp (1986) discusses the potential of the Backbone to be utilized as a reservoir in southern Indiana. The Backbone is a fine to coarse-grained limestone. Figure F.3-8 illustrates that the Backbone is thought to be approximately 250 feet thick in the vicinity of the Edwardsport site. It is estimated that it would occur at an approximate depth of 2,400 feet MSL (2,880 feet BGL).

Confinement to a Bainbridge/Backbone injection reservoir would be provided by the Devonian Age Jeffersonville and North Vernon Limestones of the Muscatatuck Group. In southwestern Indiana, both the Jeffersonville and North Vernon are comprised of fine to medium-grained limestone. Several feet of sandstone that comprise the Dutch Creek Sandstone Member occur within the Jeffersonville in southwestern Indiana. Figures F.3-9 illustrates the thickness of the North Vernon Limestone in southwestern Indiana.

The Late Devonian to Early Mississippian Age New Albany Shale would provide low permeability confinement for a Bainbridge/Backbone injection reservoir. The New Albany is described as dark-greenish, well-laminated, carbon-rich calcareous shale (Rupp, 1991). The New Albany is thought to be approximately 150 feet thick in the vicinity of the site, and to occur at an approximate depth of 2,050 feet MSL (2,530 feet BGL).

The Mississippian Age Edwardsville Formation and New Providence Shale of the Borden Group would provide additional confinement for a Bainbridge/Backbone reservoir. The Spickert Knob Formation of the Borden Group appears to be absent in the vicinity of the Edwardsport site. The Borden Group is composed primarily of calcareous siltstone and shale, and includes subordinate amounts of fine-grained sandstone and dolomitic limestone. The Borden Group is thought to be approximately 150 feet thick in the vicinity of the site. The top of the Edwardsville Formation is thought to occur at an approximate depth of 1,900 feet MSL (2,380 feet BGL).

The remainder of the Mississippian Age Formations would provide additional protection for the lowermost USDW. These geologic units include those of the Sanders Group, the Blue River Group, the West Baden Group, and the Stephensport. The Sanders Group is composed primarily of carbonate sediments. The Sanders is thought to be approximately 600 feet thick, and to occur at an approximate depth of 1,300 feet MSL (1,780 feet BGL) in the vicinity of the site. The Blue River Group is comprised of interbedded fine-grained limestones, dolomites, and evaporites arranged in a cyclic upward shoaling to supratidal sequence. Figures F.3-10 illustrates that the Blue River Group is thought to be approximately 500 feet thick, and occur at a depth of approximately 800 feet MSL (1,280 feet BGL) in the vicinity of the Edwardsport site.

The West Baden Group is a sequence of alternating clastic and carbonate formations. The uppermost member of the West Baden, the Cypress Formation, may have sufficient porosity and permeability to serve as an injection reservoir. However, Subsurface does not feel that sufficient confinement strata occur between the Cypress and the base of the lowermost USDW. Also, it appears that several old improperly plugged boreholes penetrate the Cypress within the area Figures F.3-11 illustrates that the West Baden Group is thought to be approximately 140 feet thick and to occur at an approximate depth of 660 feet MSL (1,140 feet BGL) in the vicinity of the site.

The Stephensport Group is comprised of approximately equal parts of limestone, shale, and sandstone. An erosional unconformity exists between the top of the Stephensport and the overlying Pennsylvanian Age Formations. Rocks of the Mississippian Age Buffalo Wallow Group have been eroded or were not deposited in the vicinity of the site. In addition, a portion of the uppermost unit of the Stephensport, the Glen Dean Limestone, has likely been eroded away. The Stephensport Group is expected to be approximately 130 feet thick in the vicinity of the site.

The Pennsylvanian System in the vicinity of the Edwardsport site is comprised in ascending order of the Raccoon Creek, Carbondale, and McLeansboro Groups. A number of coal beds are present in the Pennsylvanian strata. Anticlinal and synclinal structures occur in some of the coal beds in Knox County. These structures may be present due to Mississippian structures or topography of the Mississippian-Pennsylvanian unconformity (Harper and Eggert, 1995). Figure F.3-12 is a map of Knox County illustrating structure on top of the Springfield Coal.

F.4 Confining and Injection Zone Geology

Confining Zone

The confining zone for a Class I injection well is defined as "a geological formation, group of formations, or part of a formation that is capable of limiting fluid movement above an injection zone". The deepest well within the AOR for which geologic information is available is IGS ID #101250 completed to a depth of 2,641 feet bgl. Due to the lack of specific reservoir data in the immediate area, Duke prefers to have the option to locate the injection interval from the top of the Trenton Limestone to the Mt. Simon Sandstone - with a final location being determined from testing completed during well construction.

The confining zone would be the Scales Shale, Ft. Atkinson Limestone, and the Brainard Shale of the Maquoketa Group (top estimated to be located at a depth of 3630 feet bgl). No penetrations are known to exist through this group in the AOR. These units are estimated to be approximately 300 feet thick.

There are no known natural or induced fractures in the Maquoketa confining zone within the AOR. Consequently, no local permeability data is available. Cores will be taken from this series (see Attachment I for details) in the proposed first well to verify the confining properties of the formation.

Injection Zone

The injection zone for a Class I injection well is defined as "a geological formation, group of formations, or part of a formation receiving fluids through a well". Due to the lack of reservoir data in the immediate area, Duke prefers to have the option to locate the injection interval from the top of the Trenton Limestone (top at 3,930 feet bgl) to the Mt. Simon Sandstone (bottom at 9,480 feet bgl) - with a final location being determined from testing completed during well construction.

The emplacement of fluid into a subsurface strata requires an injection interval to have sufficient height, permeability and areal extensiveness to receive fluid without initiating or propagating new fractures. The rate and volume that fluid can be injected into an injection reservoir are a function of its depth, pore volume, pore pressure, fluid properties, height, permeability, and fracture closure pressure.

The following summarizes the injection zones requested for permit.

Formation Name	System (Age)	Interval Top (ft BGL)	Interval Bottom (ft BGL)	Net Thickness (feet)
Trenton Ls	Ordovician	3,930	4,055	125
St. Peter Ss Shakopee Dol	Ordovician	4,630	5,480	850
Potosi Dol	Cambrian	5,880	7,280	1,400
Mt. Simon Ss	Cambrian	8,280	9,480	1,200

There are no known natural or induced fractures in the proposed injection zone within the AOR.

F.5 Seismic Activity

The Edwardsport site is located in a region of the United States which has experienced moderate seismic activity. A seismic risk map, Figure F.5-1, has been created based on past seismic events. Moderate damage from earthquakes could be expected due to the proximity of the Wabash Valley Fault System in the southwestern corner of Indiana or the New Madrid area of southeastern Missouri. Figure F.5-2 illustrates the location of the Wabash Valley Fault System in relation to the study area. There have been a number of earthquakes recorded within an approximate 100 mile radius of the site in the past 179 years. Table F.5-1 lists the epicenter of each occurrence of seismic activity and the location, date, and intensity of the earthquakes which have occurred within an approximate 100 mile radius of the Edwardsport site.

TABLE F.5-1
Earthquakes Within 100 Miles +/- of the Edwardsport Site

Year	Month	Day	Magnitude	Distance from Site (miles)
1827	7	5	4.8 FASC	57
1827	8	7	4.8 FASC	67
1827	8	7	4.7 FABR	67
1838	6	9	5.2 FASC	95
1876	9	25	4.5 FASC	35
1876	9	25	4.8 FASC	35
1887	2	6	4.6 FASC	15
1891	7	27	4.1 FASC	63
1891	9	27	5.2 FASC	75
1899	4	30	4.9 FASC	23
1909	9	27	5.1 FASC	73
1921	3	14	4.4 FASC	49
1922	11	27	4.8 FASC	93
1925	9	2	4.6 FASC	70
1958	11	8	4.4 ASC	46
1968	11	9	5.5 MnSLM	84
1974	4	3	4.7 MnDG	46
1976	3	26	4.4 mb GS	47
1978	9	23	4.3 mb GS	87
1978	12	8	5.1 mb GS	70
1979	6	15	4.7 mb GS	83
1979	6	15	4.8 mb GS	59
1979	11	16	4.4 mb GS	93
1980	7	6	4.7 mb GS	90
1980	8	23	4.8 mb GS	63
1981	10	8	4.5 mb GS	88
1982	3	1	4.3 mb GS	98
1983	11	15	4.5 mb GS	21
1984	10	22	4.6 mb GS	45
1984	6	29	4.1 MnGs	98
1986	11	7	4.7 mb GS	21
1987	8	3	5 mb GS	88
1987	6	10	5.2 MnSLM	37

TABLE F.5-1 (Continued)

Earthquakes Within 100 Miles +/- of the Edwardsport Site

Year	Month	Day	Magnitude	Distance from Site (miles)
1988	2	3	4.4 mb GS	75
1989	4	15	4.4 mb GS	30
1989	7	4	4.2 mb GS	7
1990	4	22	4.7 mb GS	96
1991	10	17	5.1 mb GS	86
1991	12	8	4.7 mb GS	92
1993	2	23	4.3	62
1993	2	23	4.7 MwHRV	64
1994	2	4	4.7 mb GS	94
1995	8	12	Unrecorded	86
1997	2	5	4.6 mb GS	70
1997	5	9	3.2 mb GS	83
1998	2	9	3.2 mb GS	91
1998	6	26	4.5 mb GS	60
1998	6	26	Unrecorded	42
1998	10	1	4 mb GS	48
1998	11	11	Unrecorded	81
1999	4	13	3.6 mb GS	76
1999	8	8	3.8 mb GS	95
2000	1	12	4.2 mb GS	89
2000	3	18	4.2 mb GS	43
2000	9	30	4.8 mb GS	54
2001	1	25	4.7 mb GS	96
2001	3	15	3.4 mb GS	99
2002	3	5	Unrecorded	92
2002	5	3	5.2 MwHRV	91
2002	5	3	5.1 MwHRV	94
2002	5	28	4.9 MwHRV	68
2002	7	9	4.3 mb GS	58
2003	1	19	4.1 mb GS	66
2004	6	26	Unrecorded	49

TABLE F.5-1 (Continued)

Earthquakes Within 100 Miles +/- of the Edwardsport Site

Year	Month	Day	Magnitude	Distance from Site (miles)
2005	2	28	3.5 mb GS	71
2005	2	28	3.6 mb GS	72
2005	6	23	4.1 mb GS	94
2005	7	28	4.4 mb GS	71
2005	9	16	4.1 mb GS	66
2005	12	25	4 mb GS	96
2006	3	27	4.2 mb GS	70
2006	5	12	4.1 mb GS	93

Source: U. S. Geological Survey Earthquake Data Base (National Earthquake Information Center)

All of the earthquakes that have occurred have been mild, having an intensity of VII or less on the Modified Mercalli Intensity Scale, and have been epicentered outside of the Edwardsport site AOR.

The lack of seismic activity coupled with the lack of faulting within the vicinity of the site reinforces the choice of this site for a waste disposal well.

F.6 Geologic References

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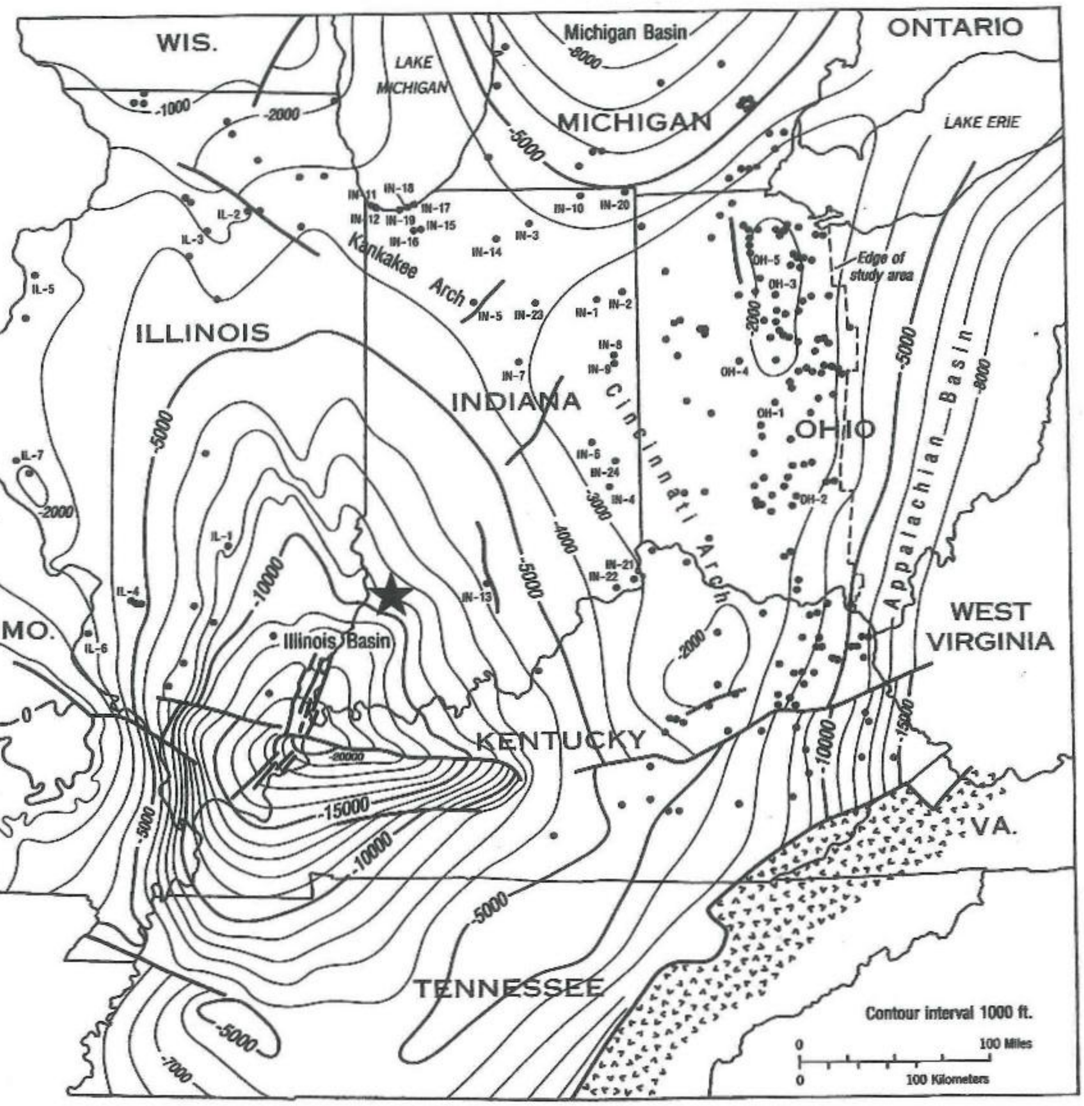


LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.1–1

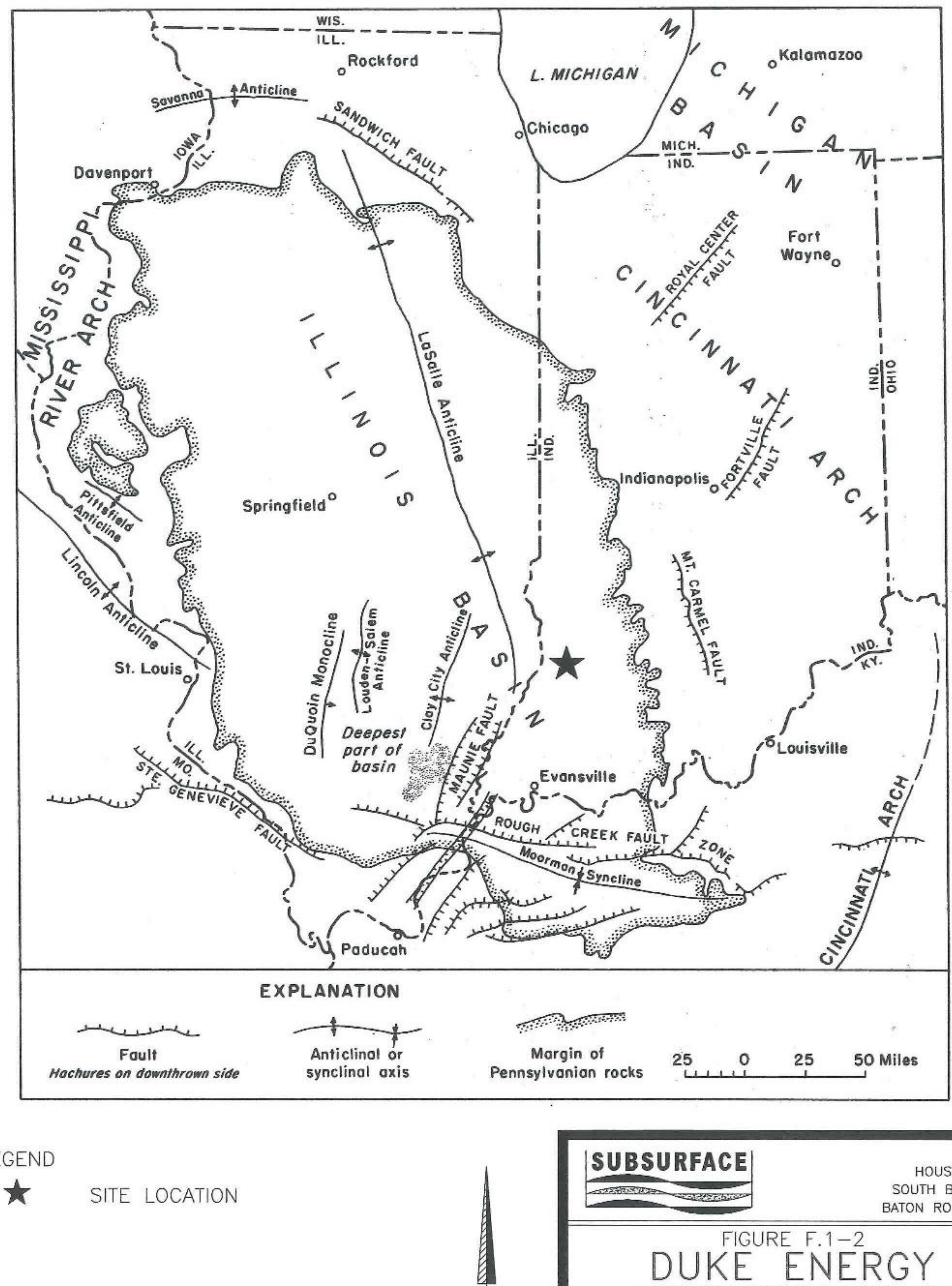
DUKE ENERGY

EDWARDSPORT FACILITY

GEOLOGIC SETTING OF ILLINOIS BASIN

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUDMAN AND RUPP, 1993



SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.1-2

DUKE ENERGY

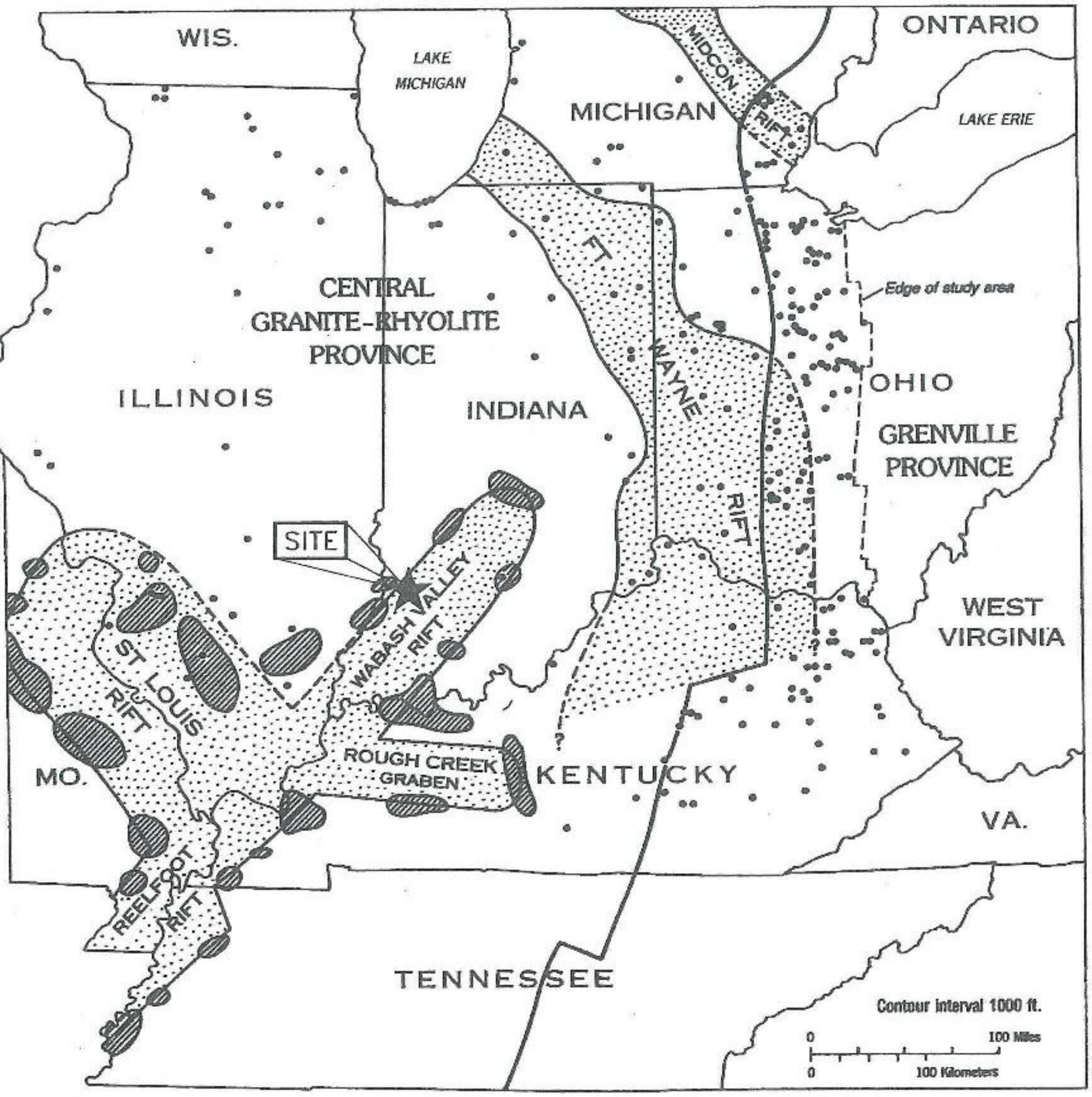
EDWARDSPORT FACILITY

GEOLOGIC STRUCTURE OF THE EASTERN INTERIOR

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: SHAVER AND AUSTIN, 1972

APR 2008



LEGEND

★ SITE LOCATION

• TEST LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.1-3

DUKE ENERGY

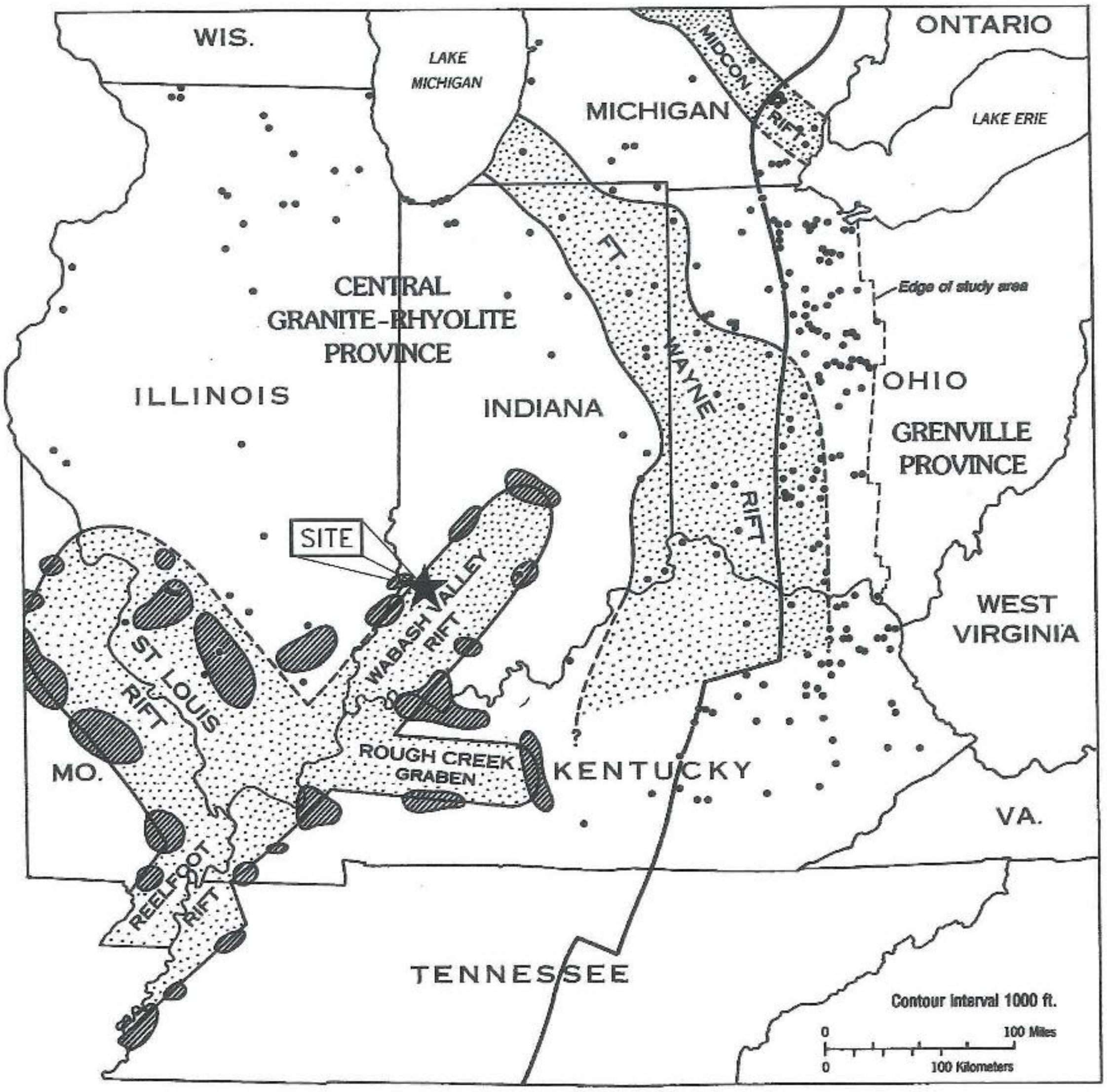
EDWARDSPORT FACILITY

MAP OF THE MIDWEST SHOWING THE LOCATIONS OF BASEMENT TESTS AND INTERPRETED PROVINCES BASED ON LITHOGRAPHY

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUDMAN AND RUPP, 1993

MAR —— 2007



LEGEND

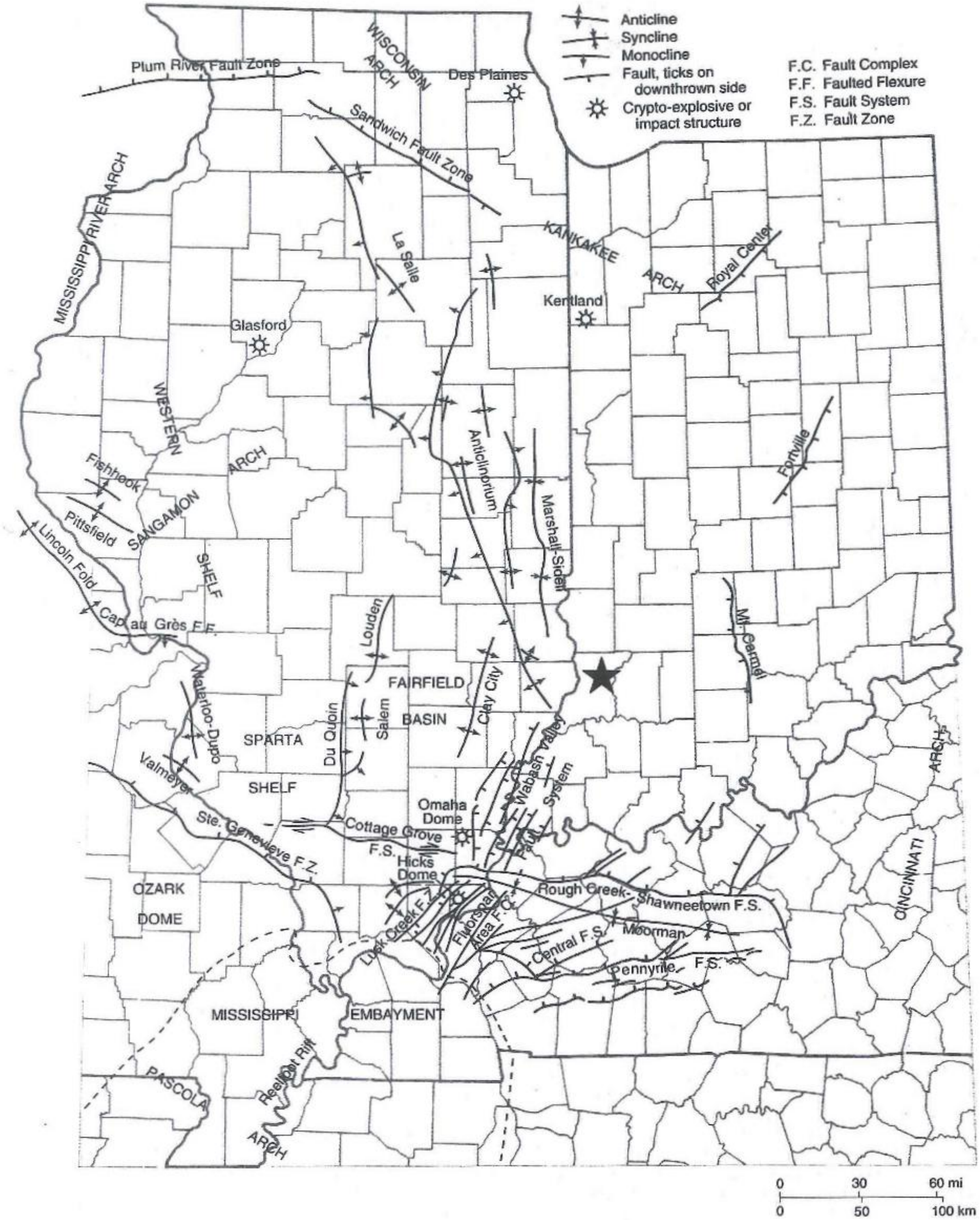
★ SITE LOCATION

SOURCE: RUDMAN AND RUPP, 1993

SUBSURFACE	HOUSTON, TX. SOUTH BEND, IN. BATON ROUGE, LA.

FIGURE F.1-3
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF THE MIDWEST SHOWING THE LOCATIONS OF BASEMENT TESTS AND INTERPRETED PROVINCES BASED ON LITHOGRAPHY

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.1-4

DUKE ENERGY

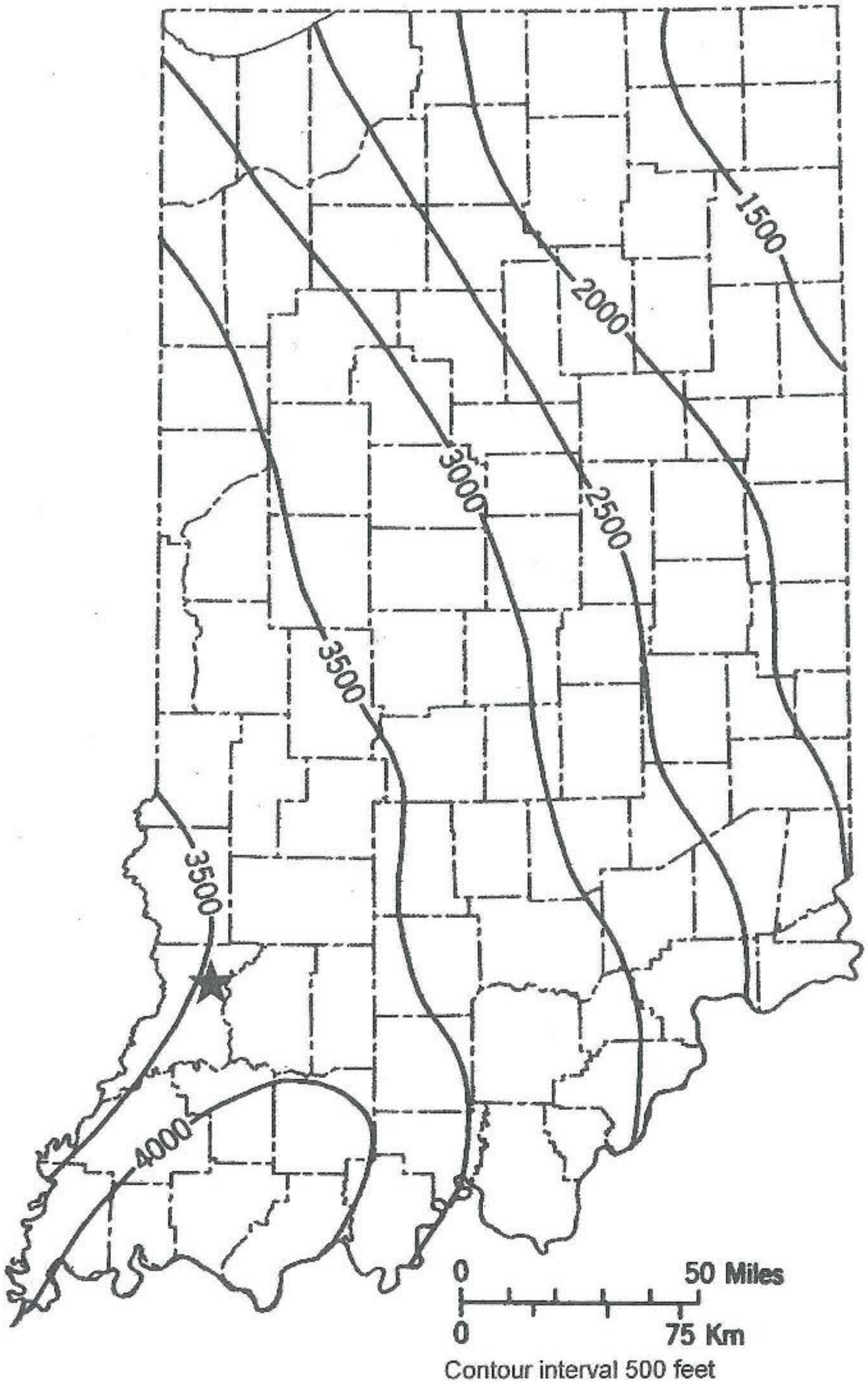
EDWARDSPORT FACILITY

MAJOR STRUCTURAL FEATURES IN ILLINOIS AND NEIGHBORING STATES

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: NELSON, 1995

APR 2008



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.2–1

DUKE ENERGY

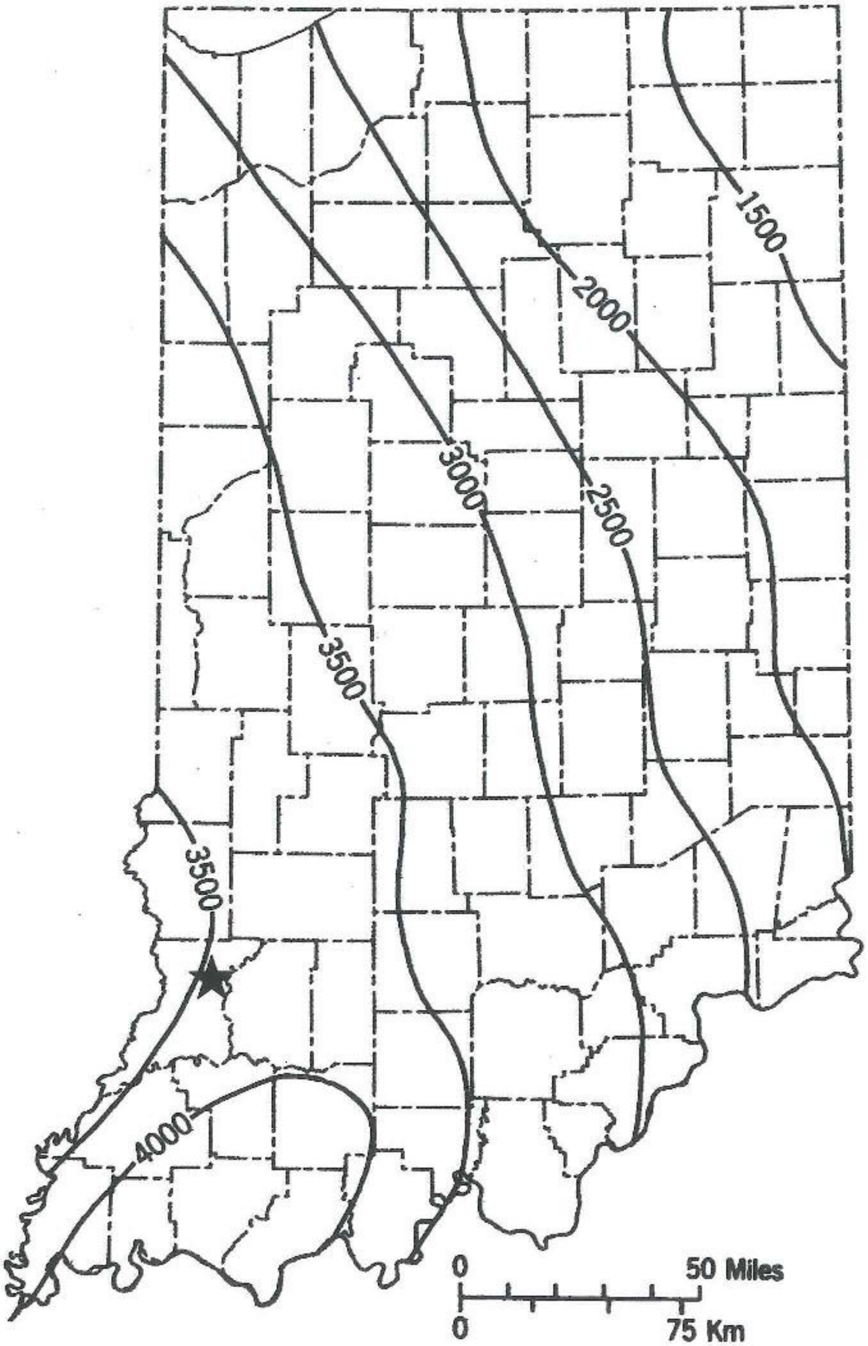
EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE CAMBRIAN SYSTEM

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND PATTON, 1985

MAR 2007



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.2–1

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE CAMBRIAN SYSTEM

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND PATTON, 1985

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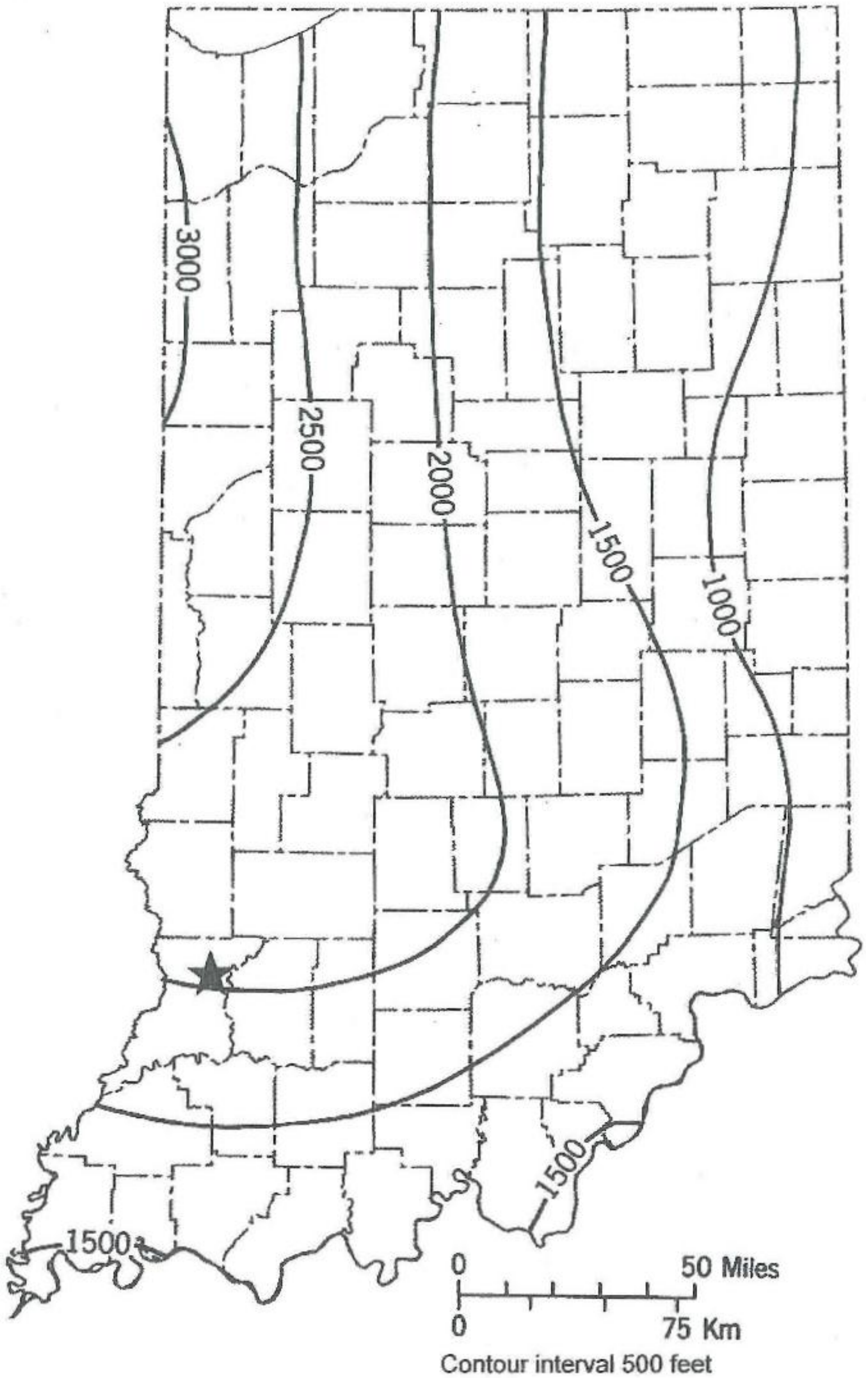


LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.2-2

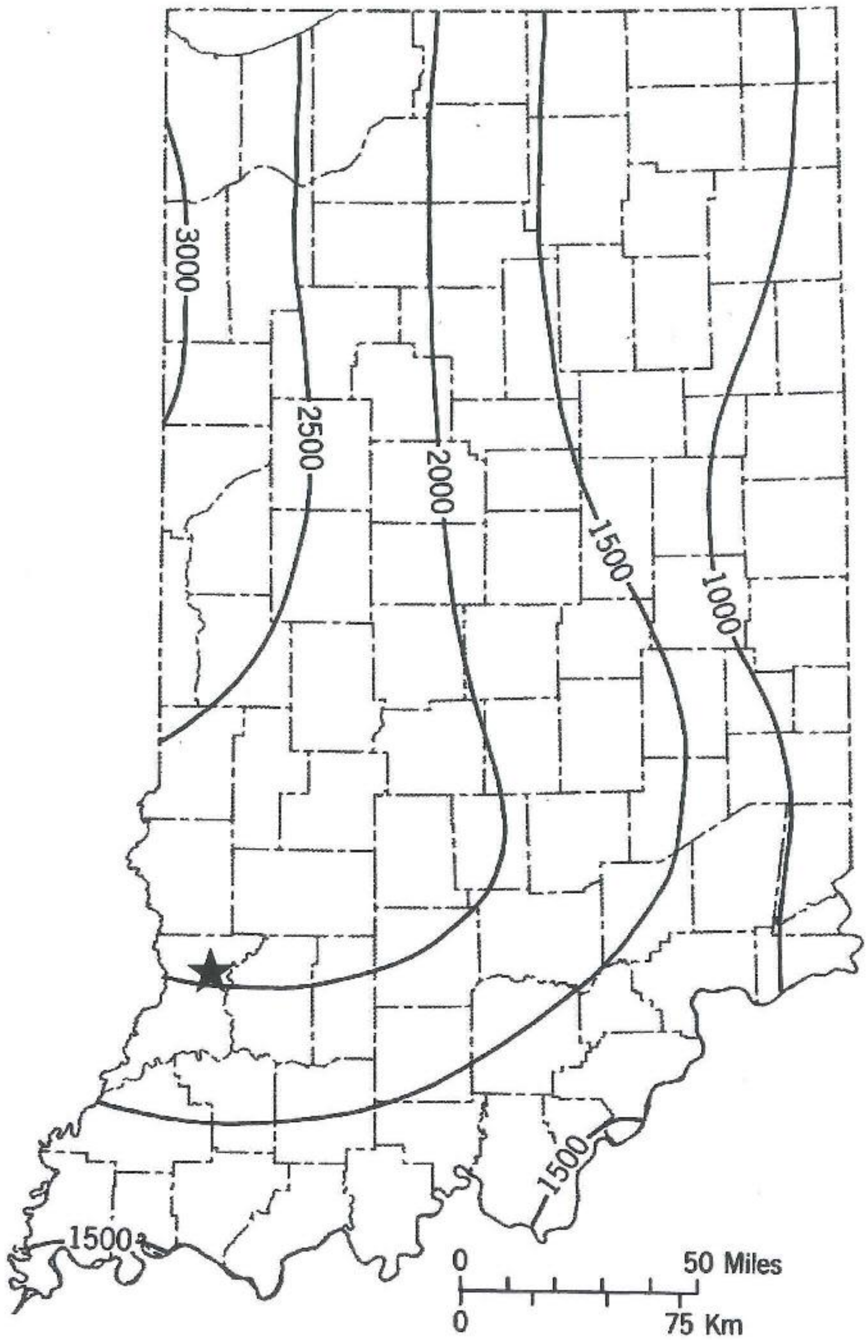
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE POTSDAM SUPERGROUP

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND PATTON, 1985



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.2–2

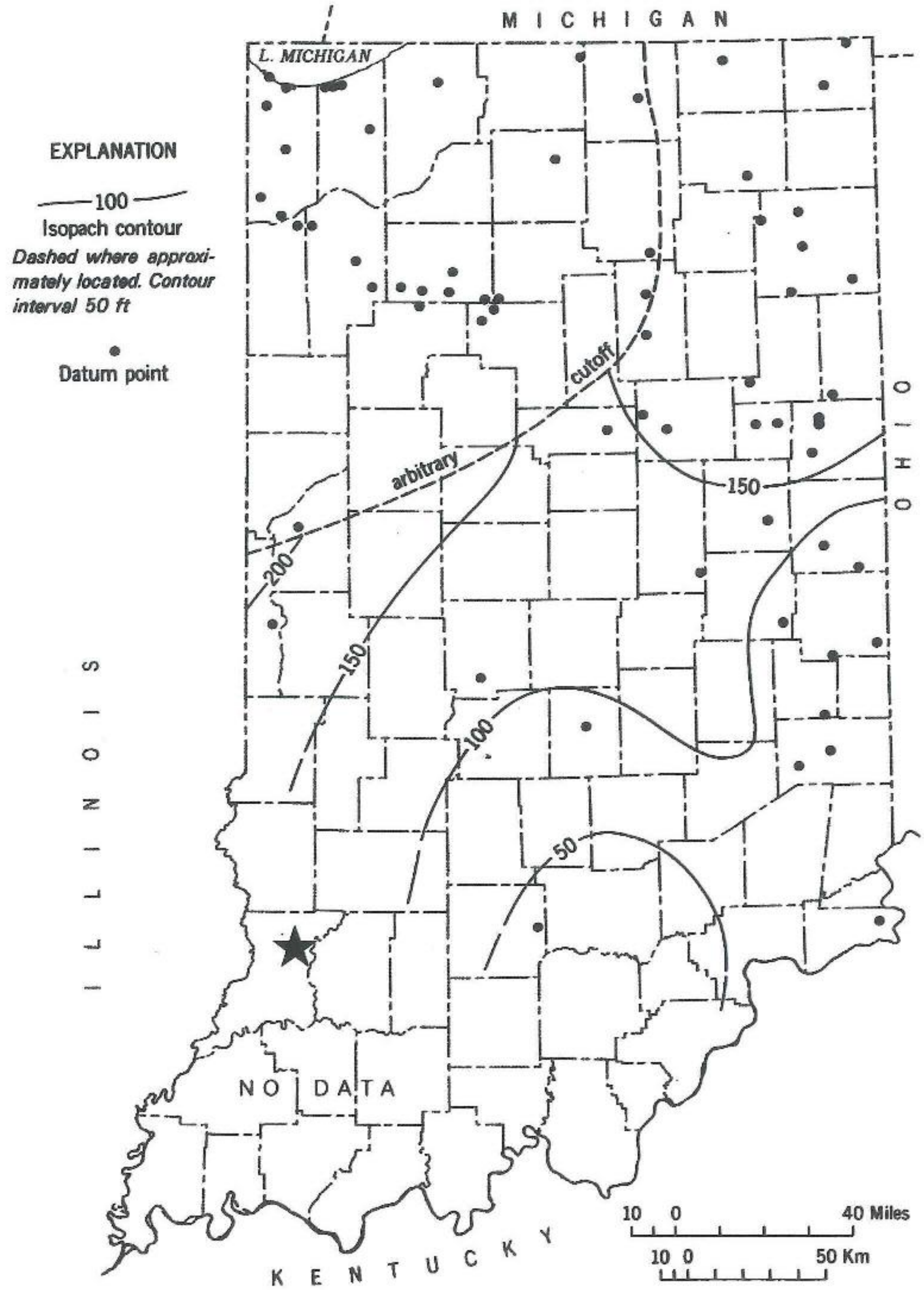
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE POTSDAM SUPERGROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND PATTON, 1985



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.2-3

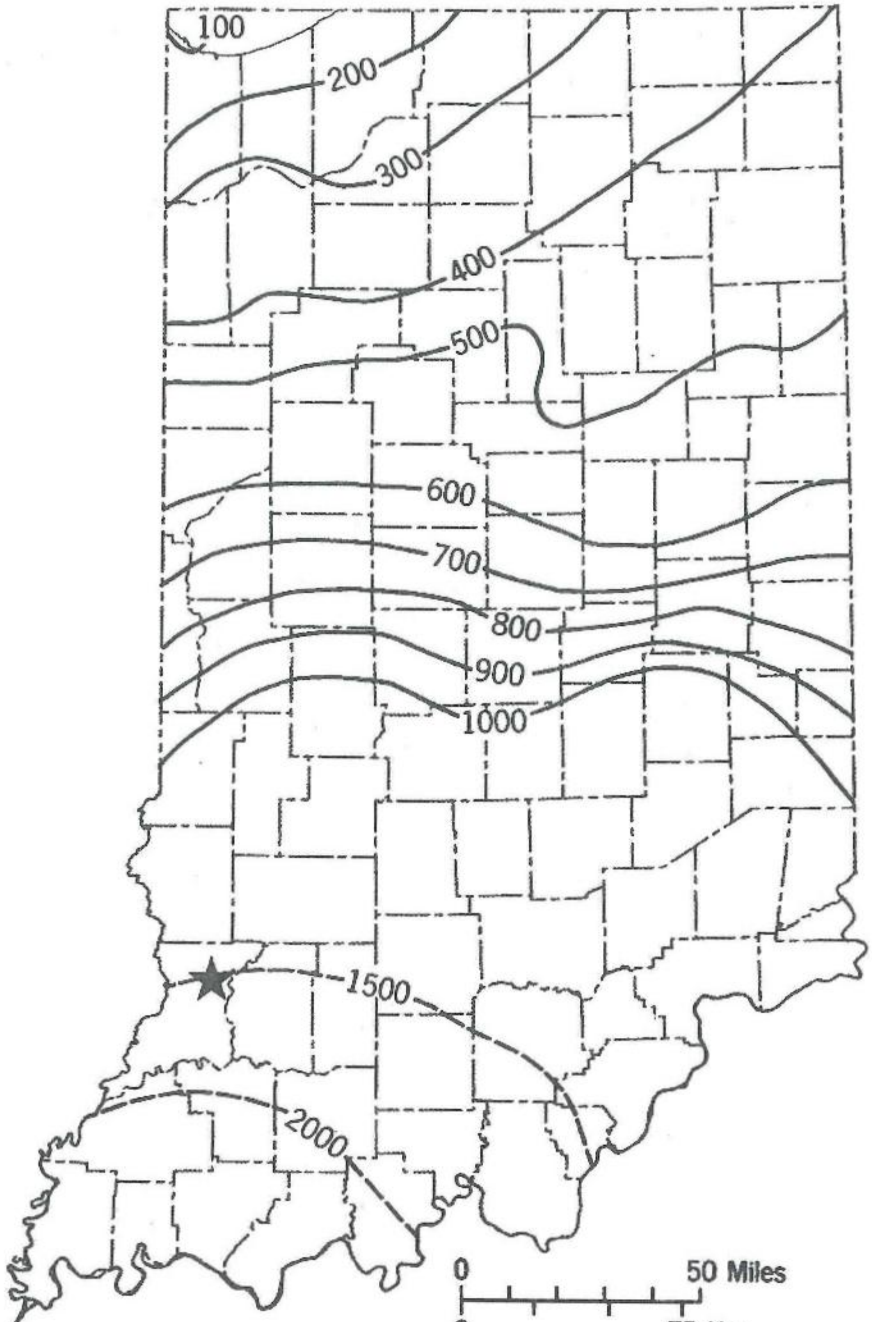
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE DAVIS FORMATION

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: BECKER, HREHA, AND DAWSON, 1978



Contour interval 100 feet to 1000 feet
and 500 feet above 1000 feet

LEGEND

★ SITE LOCATION

SOURCE: DROSTE AND PATTON, 1985

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

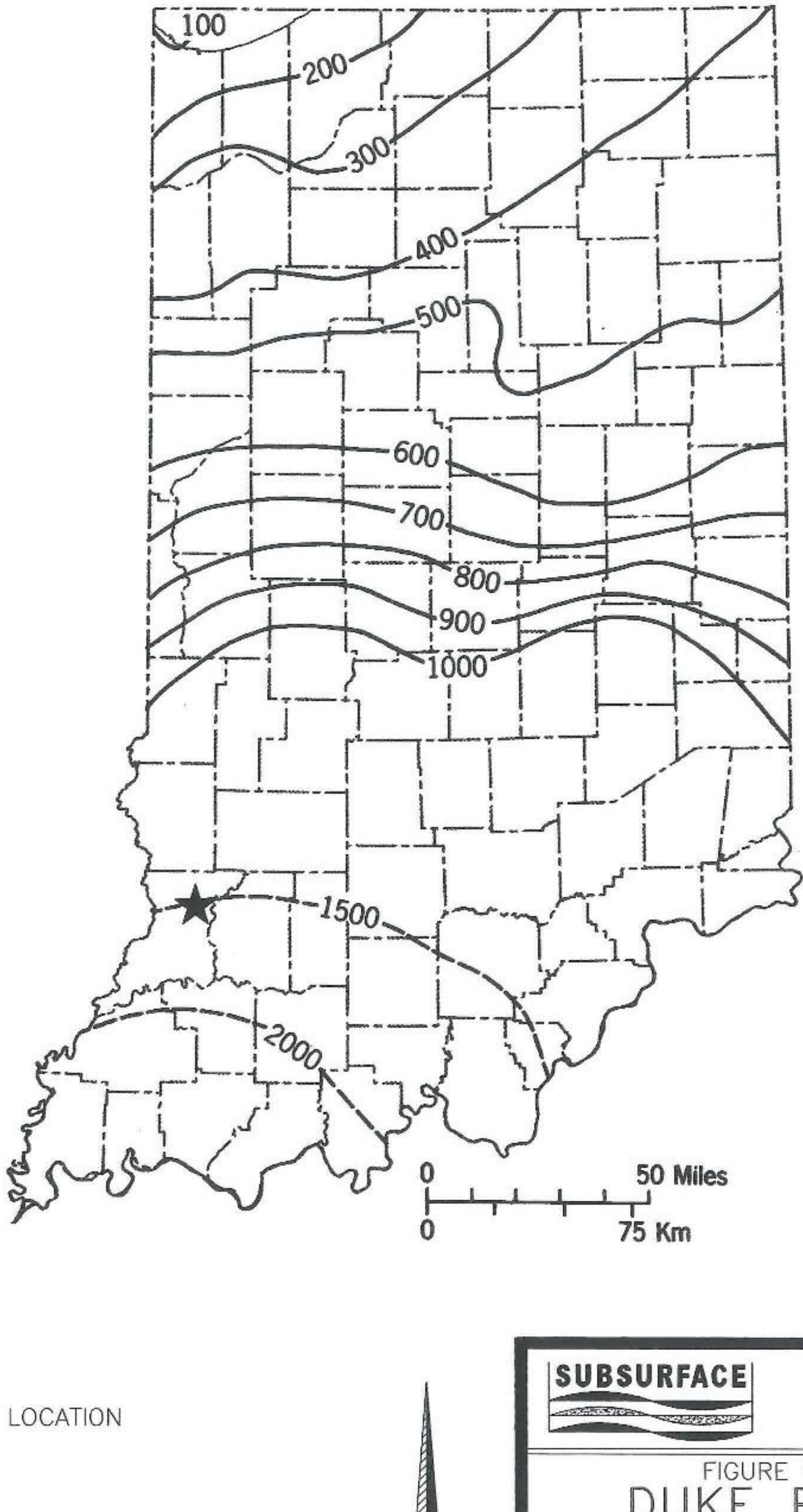
FIGURE F.2.2–4

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE POTOSI DOLOMITE

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

SOURCE: DROSTE AND PATTON, 1985

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.2–4

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE POTOSI DOLOMITE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

APR 2008

LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–1

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE ONEOTA DOLOMITE

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND PATTON, 1985

MAR 2007

LEGEND

★ SITE LOCATION

N

SUBSURFACE

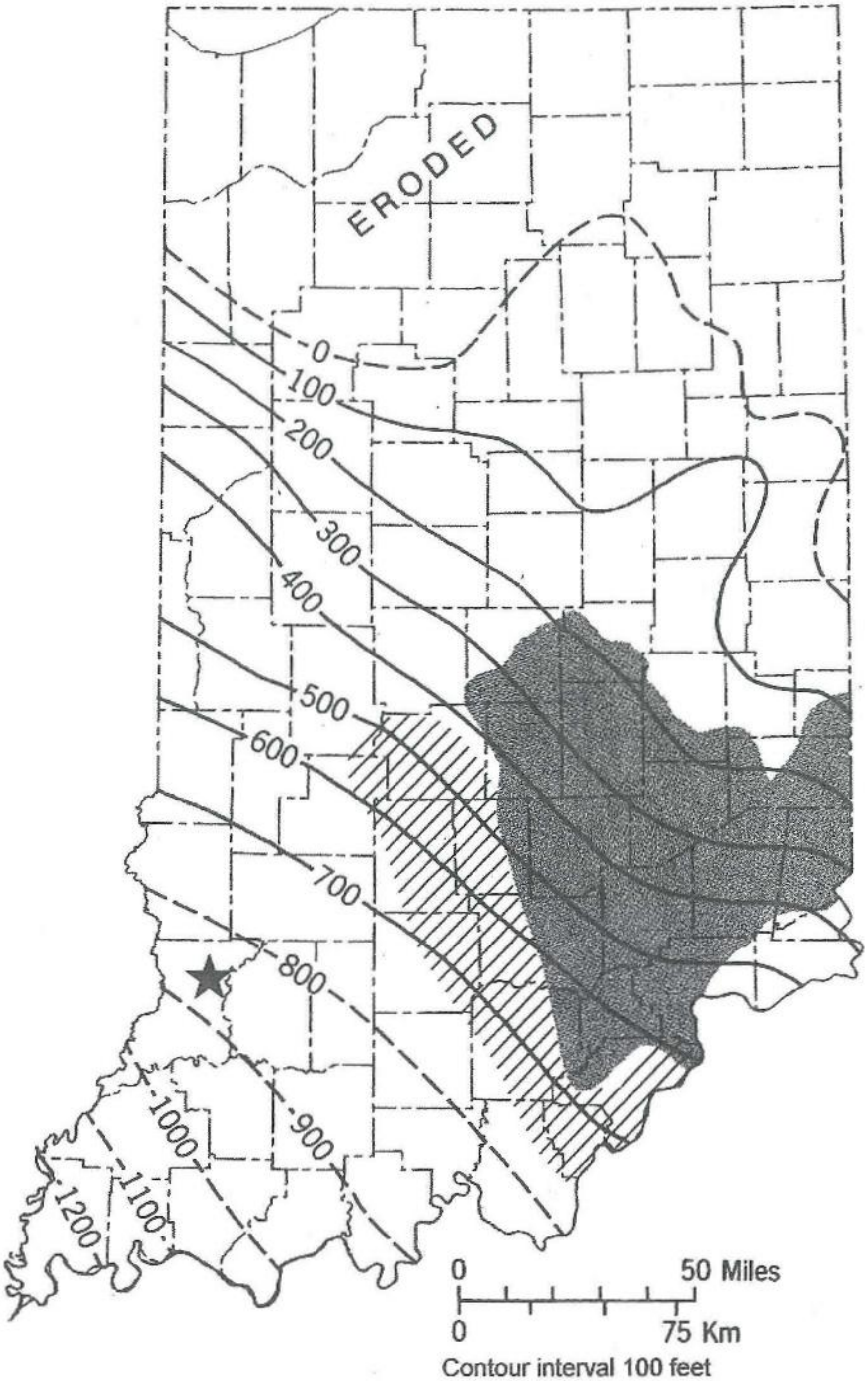
HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3−1
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF INDIANA SHOWING
THICKNESS OF THE ONEOTA DOLOMITE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND PATTON, 1985

APR 2008



LEGEND

★ SITE LOCATION

GRAY TONE INDICATES THE AREA WHERE SANDSTONES OF THE SHAKOPEE DOLOMITE LIE DIRECTLY BELOW ROCKS OF THE ANCELL GROUP AND WHERE THEY ARE PROMINENT ROCKS IN THE LOWER SHAKOPEE. LINE PATTERN INDICATES THE AREA WHERE SANDSTONES ARE PROMINENT ROCKS IN THE SHAKOPEE DOLOMITE BELOW THE TOP OF THE UNIT.

SOURCE: DROSTE AND PATTON, 1985

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3-2

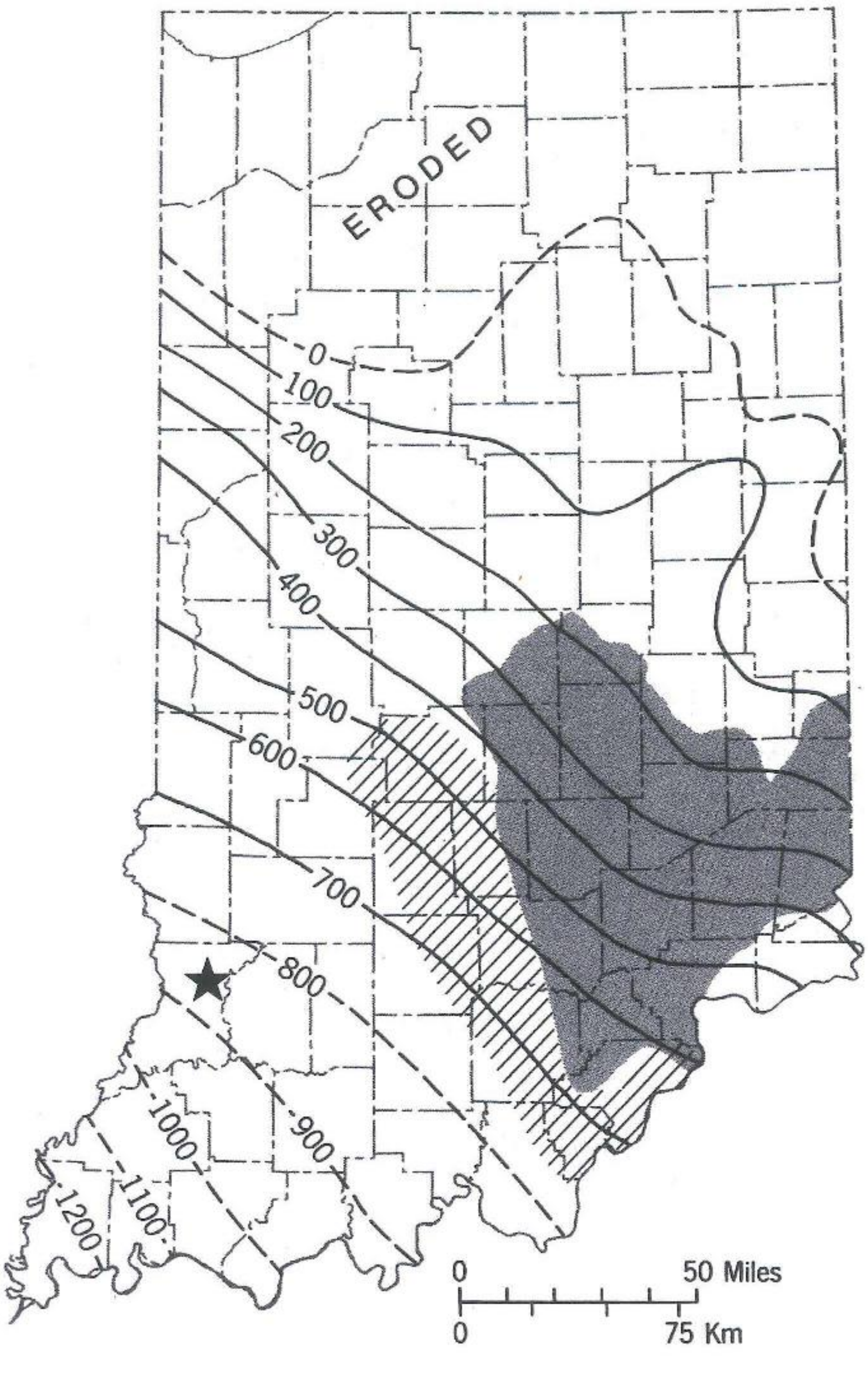
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE SHAKOPEE DOLOMITE

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

MAR 2007



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–2

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE SHAKOPEE DOLOMITE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND PATTON, 1985

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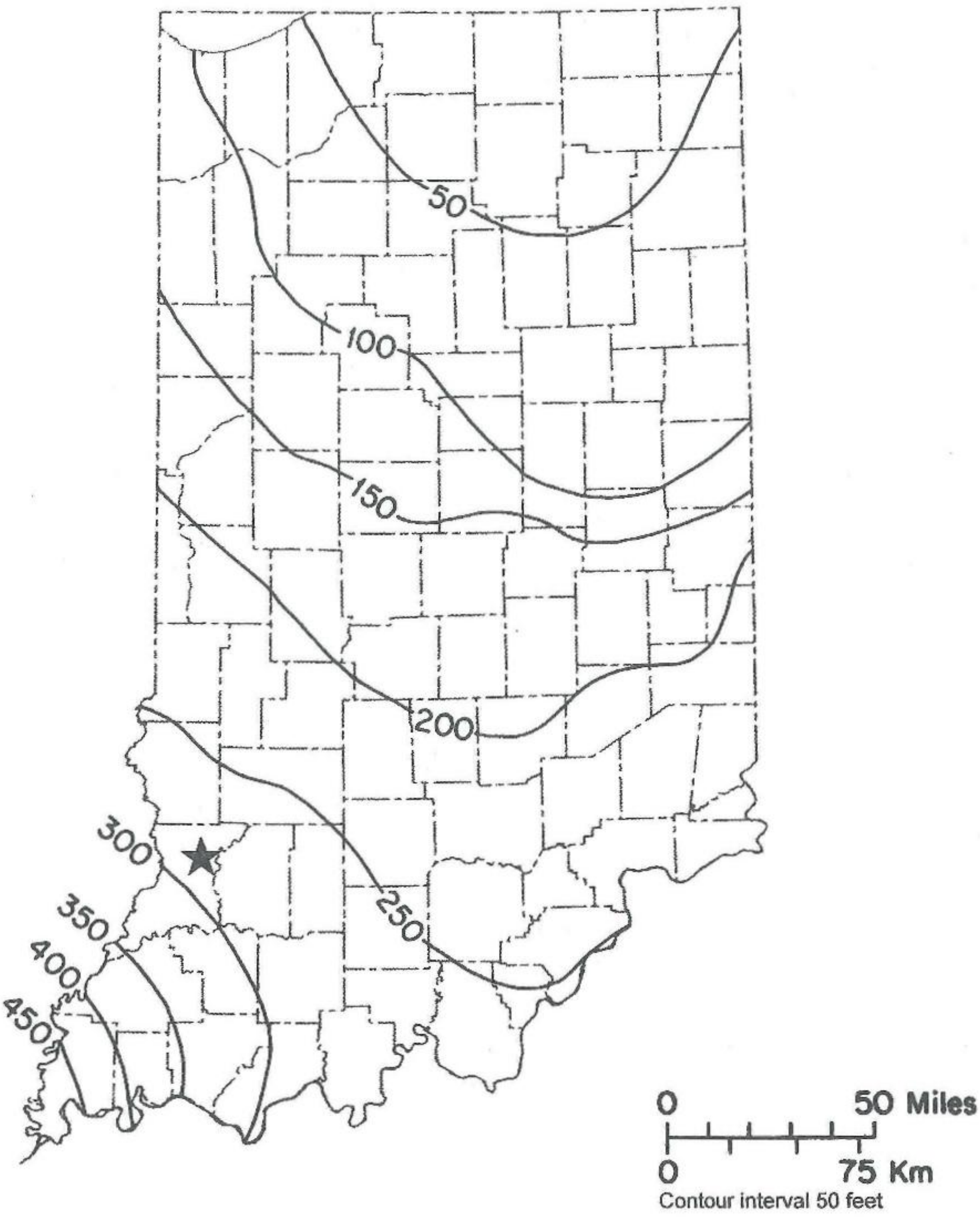

LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–3

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE ANCELL GROUP

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

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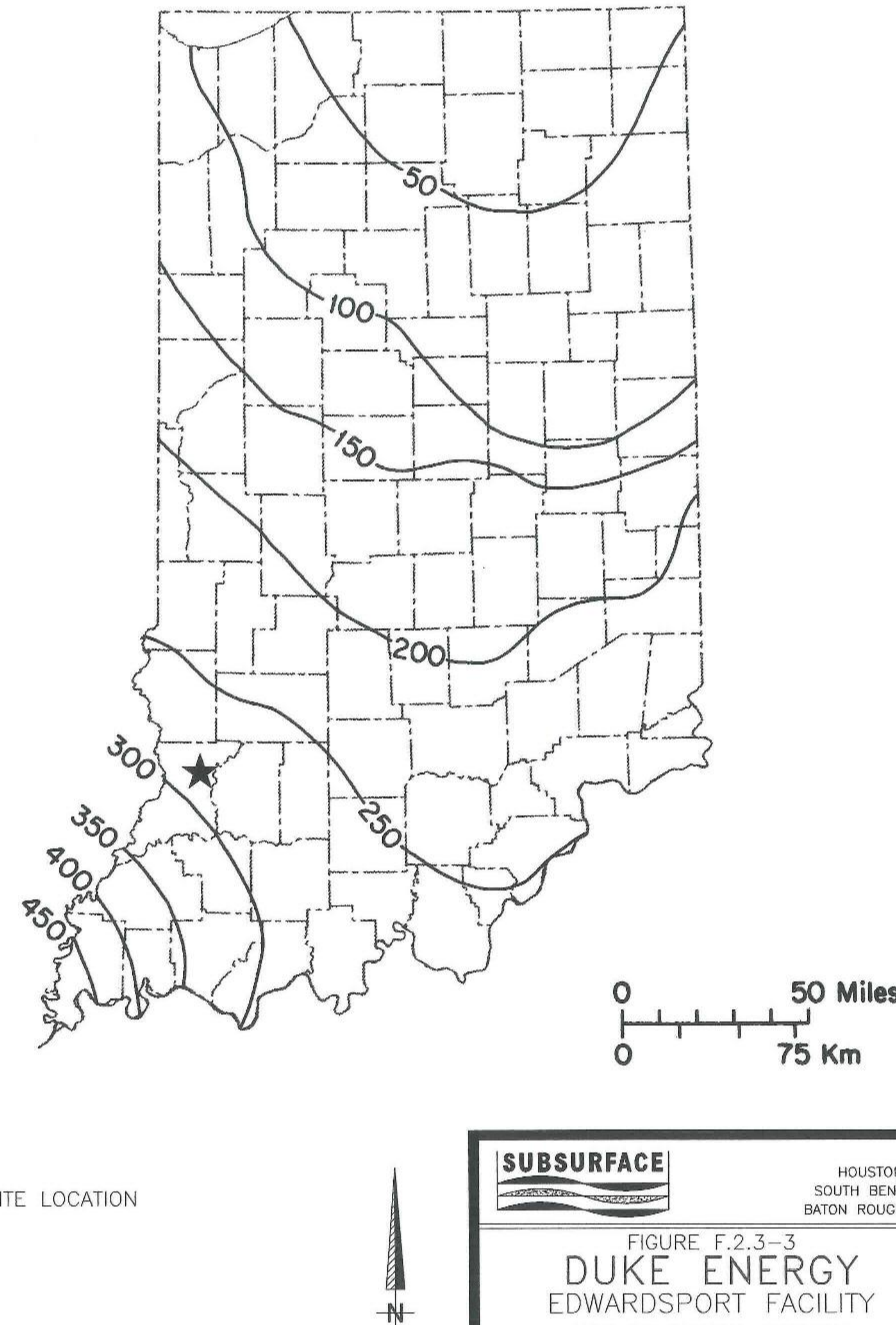


LEGEND

★ SITE LOCATION

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3-3

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE ANCELL GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

LEGEND

★ SITE LOCATION

N

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

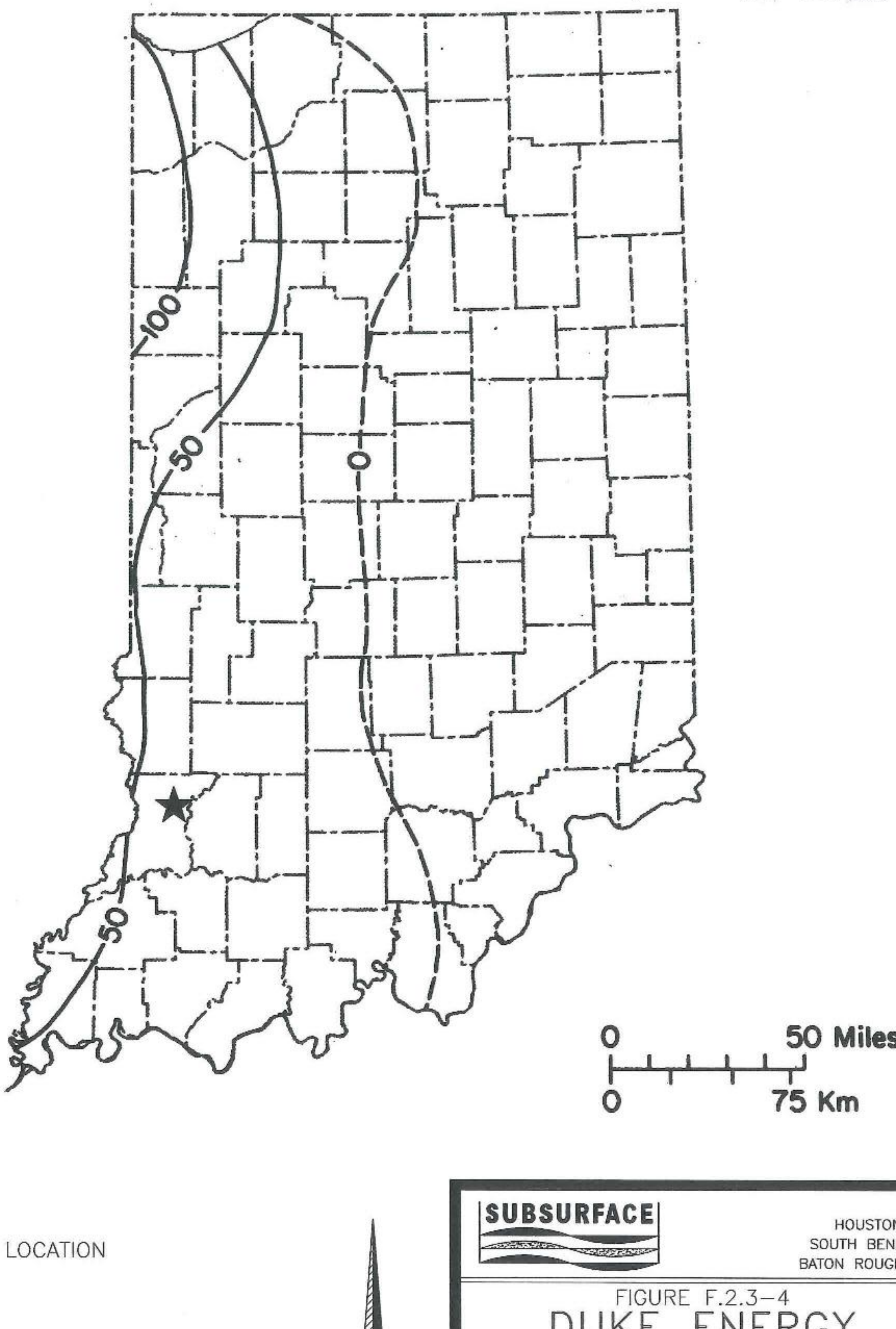
FIGURE F.2.3–4

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE ST. PETER SANDSTONE

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–4

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE ST. PETER SANDSTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3-5

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE DUTCHTOWN FORMATION

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–5

DUKE ENERGY

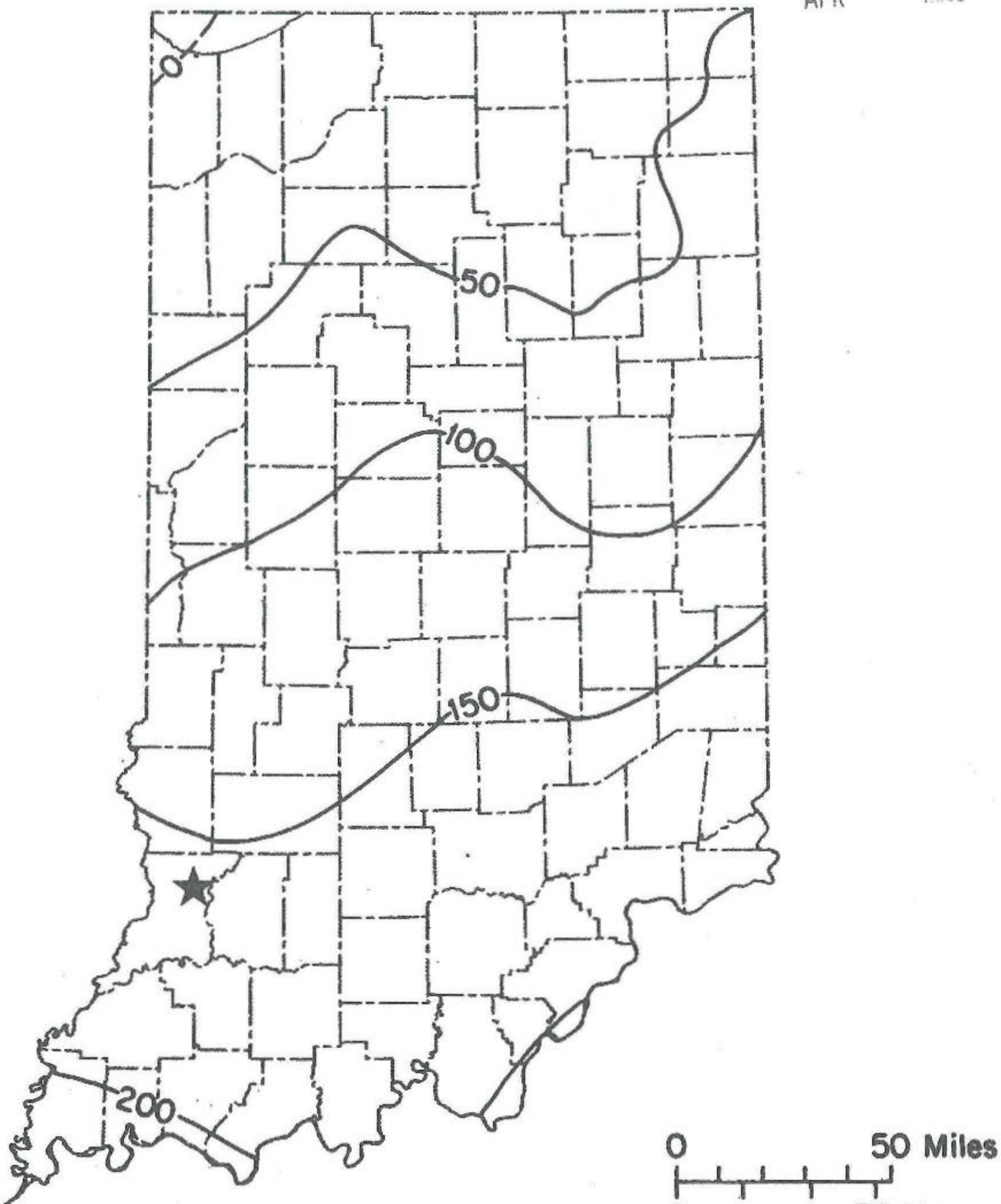
EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE DUTCHTOWN FORMATION

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

APR 2008



Contour interval 50 feet

LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–6

DUKE ENERGY

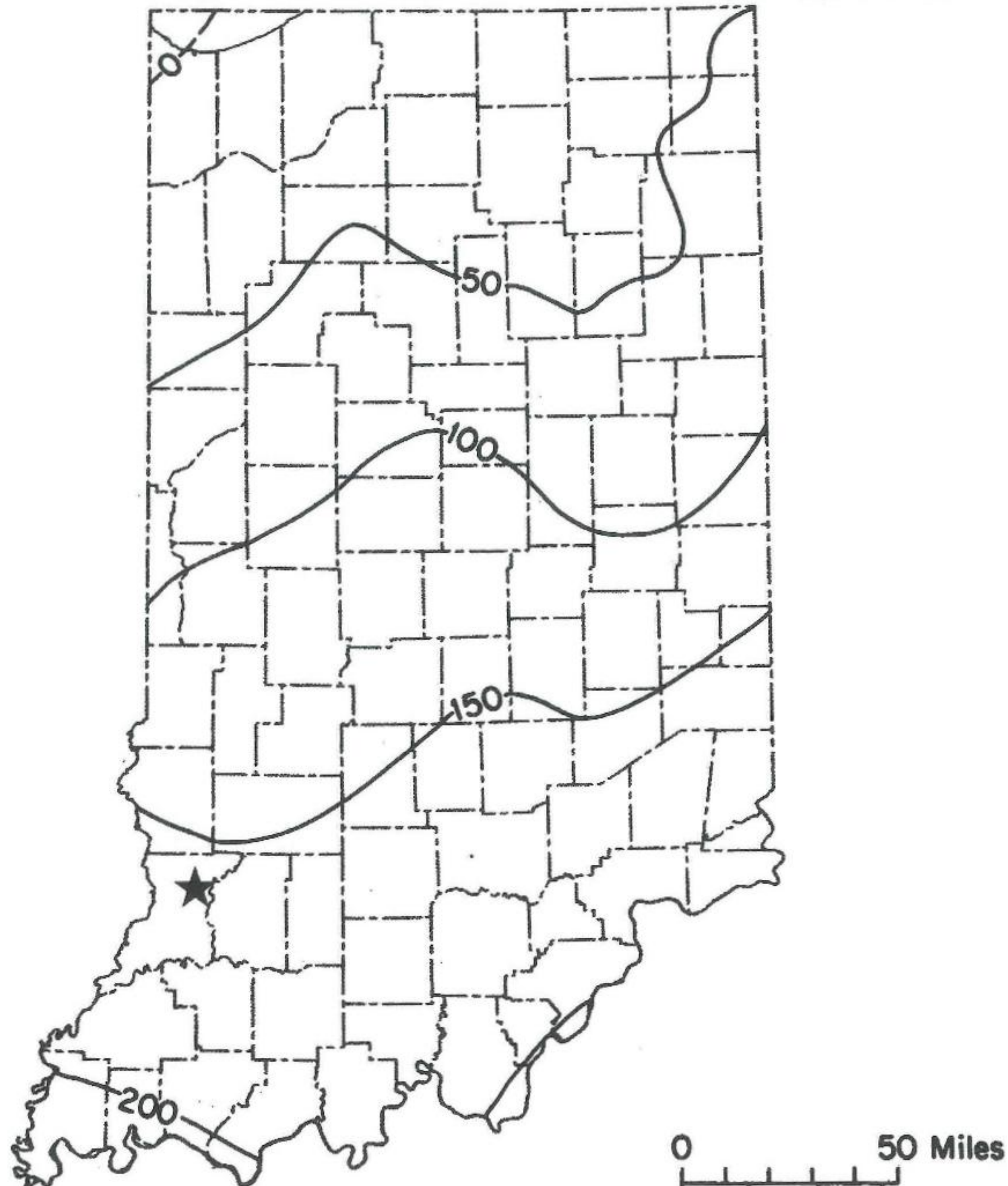
EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE JAOCHIM FORMATION

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

MAR — 2007



LEGEND

★ SITE LOCATION

N

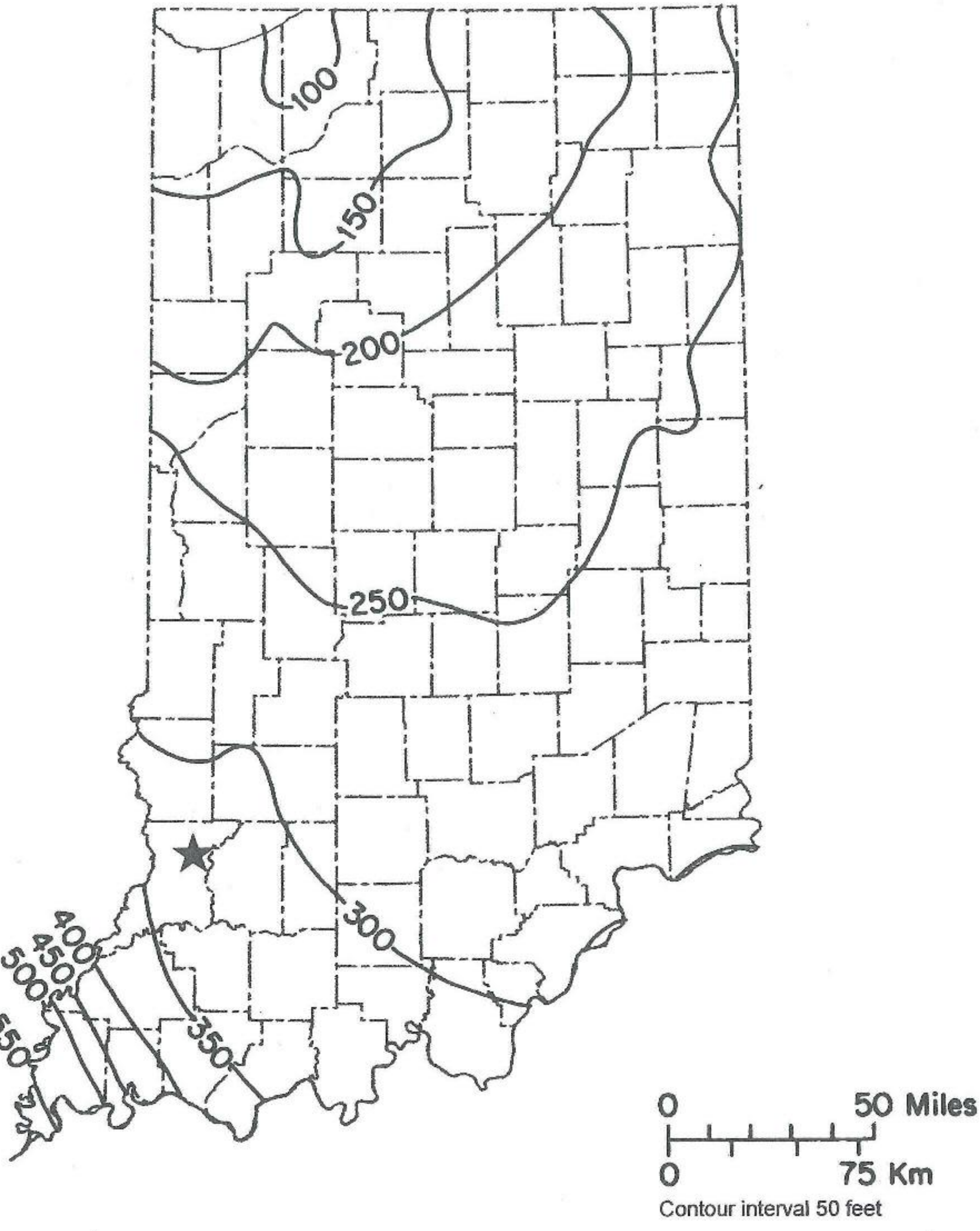
SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3-6
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF INDIANA SHOWING
THICKNESS OF THE JAOCHIM FORMATION

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982



LEGEND

★ SITE LOCATION

N

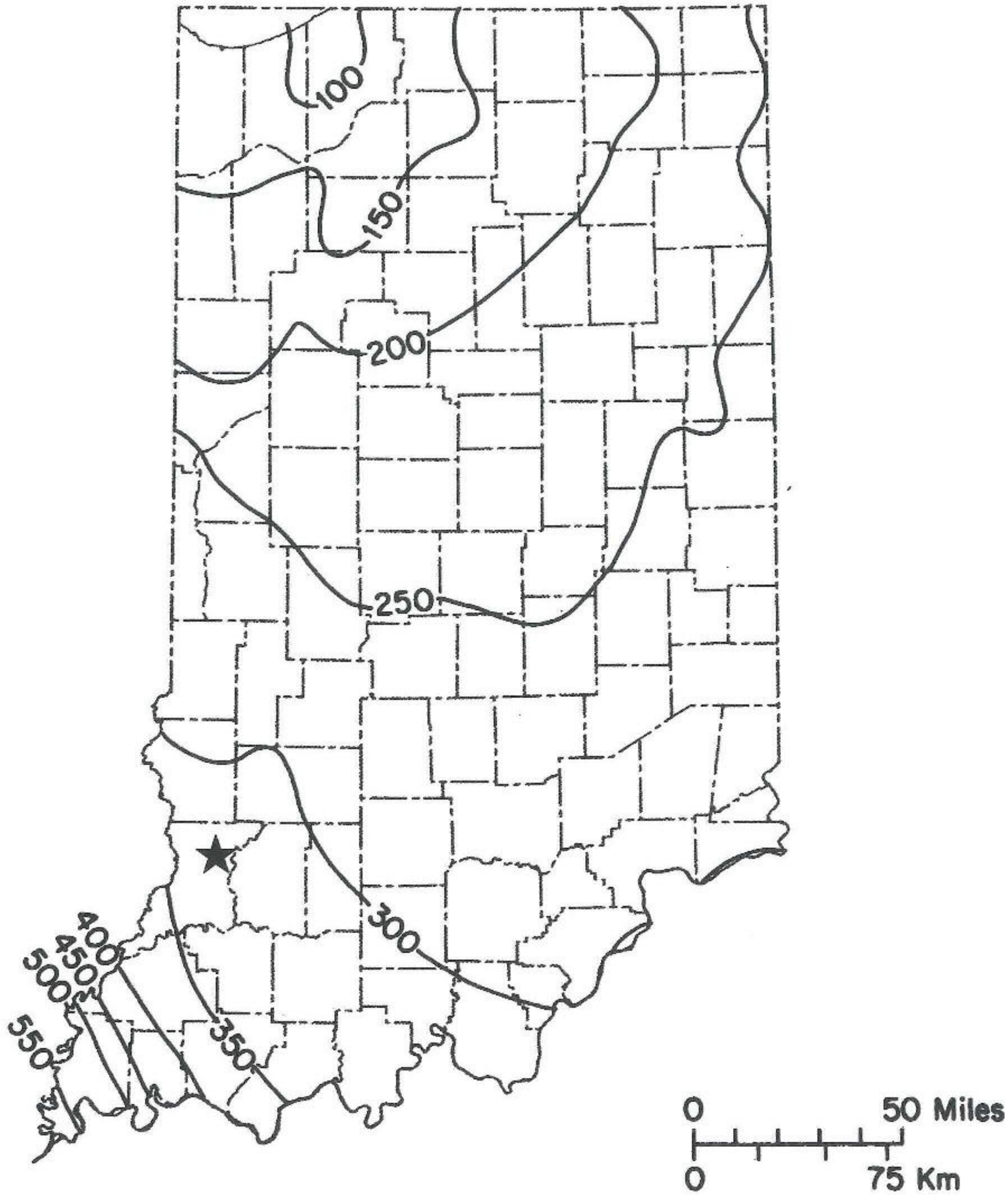
SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–7
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF INDIANA SHOWING
THICKNESS OF THE BLACK RIVER GROUP

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–7
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF INDIANA SHOWING
THICKNESS OF THE BLACK RIVER GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

APR 2008

LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–8

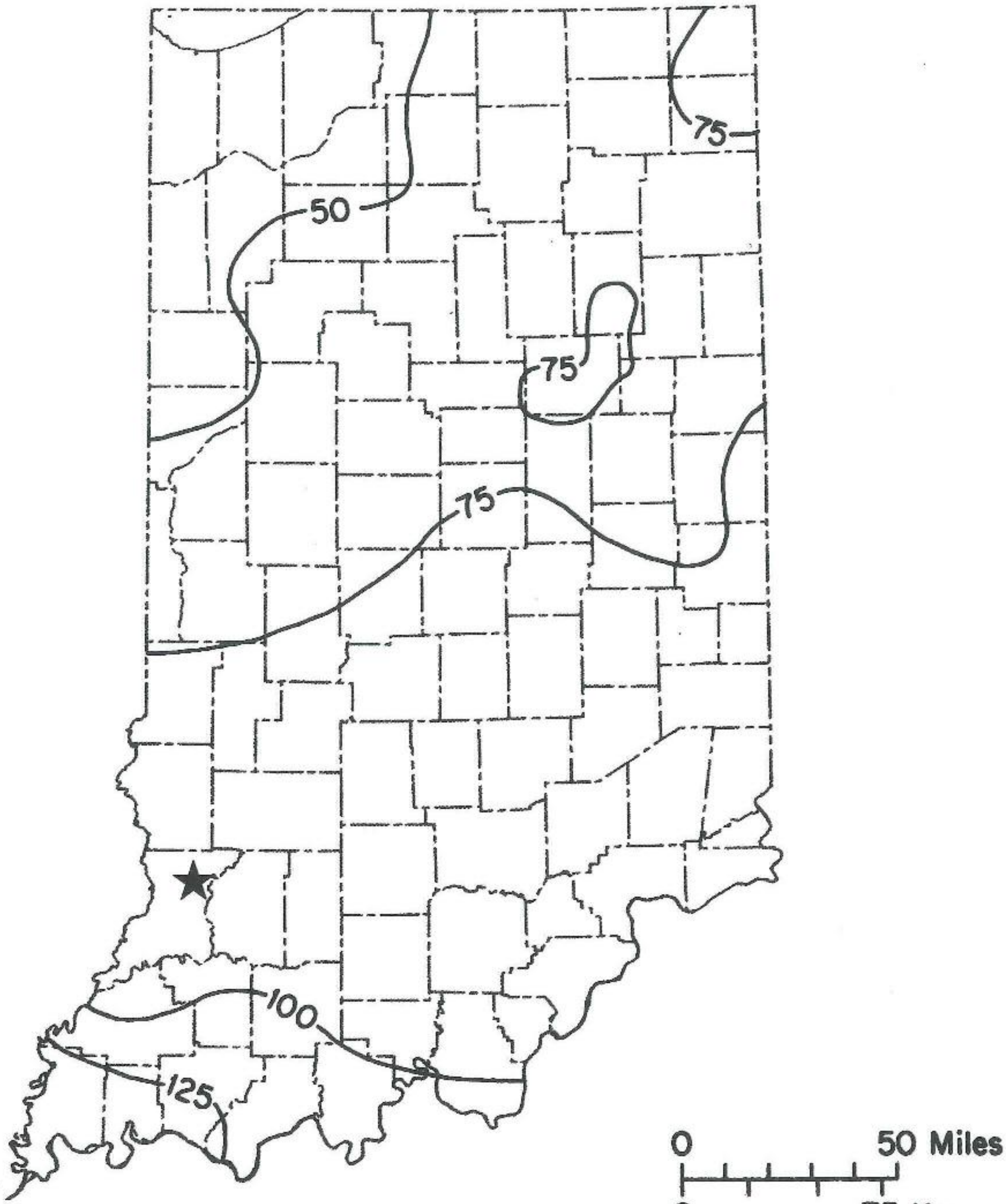
PSI ENERGY, INC.

EDWARDSPORT FACILITY

MAP SHOWING THE THICKNESS OF THE PECATONICA FORMATION IN INDIANA

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–8

PSI ENERGY, INC.

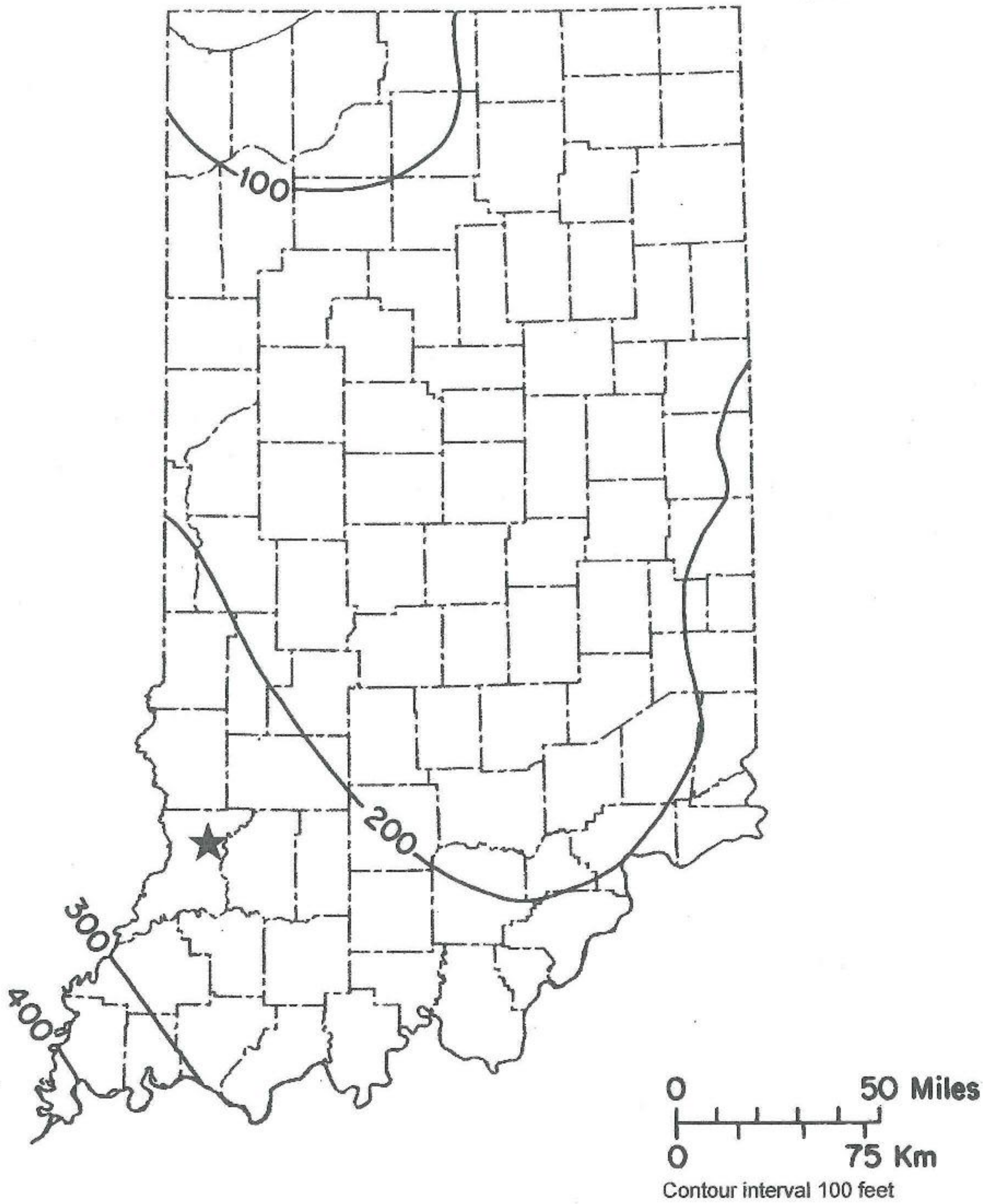
EDWARDSPORT FACILITY

MAP SHOWING THE THICKNESS OF THE PECATONICA FORMATION IN INDIANA

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982

APR 2008



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3-9

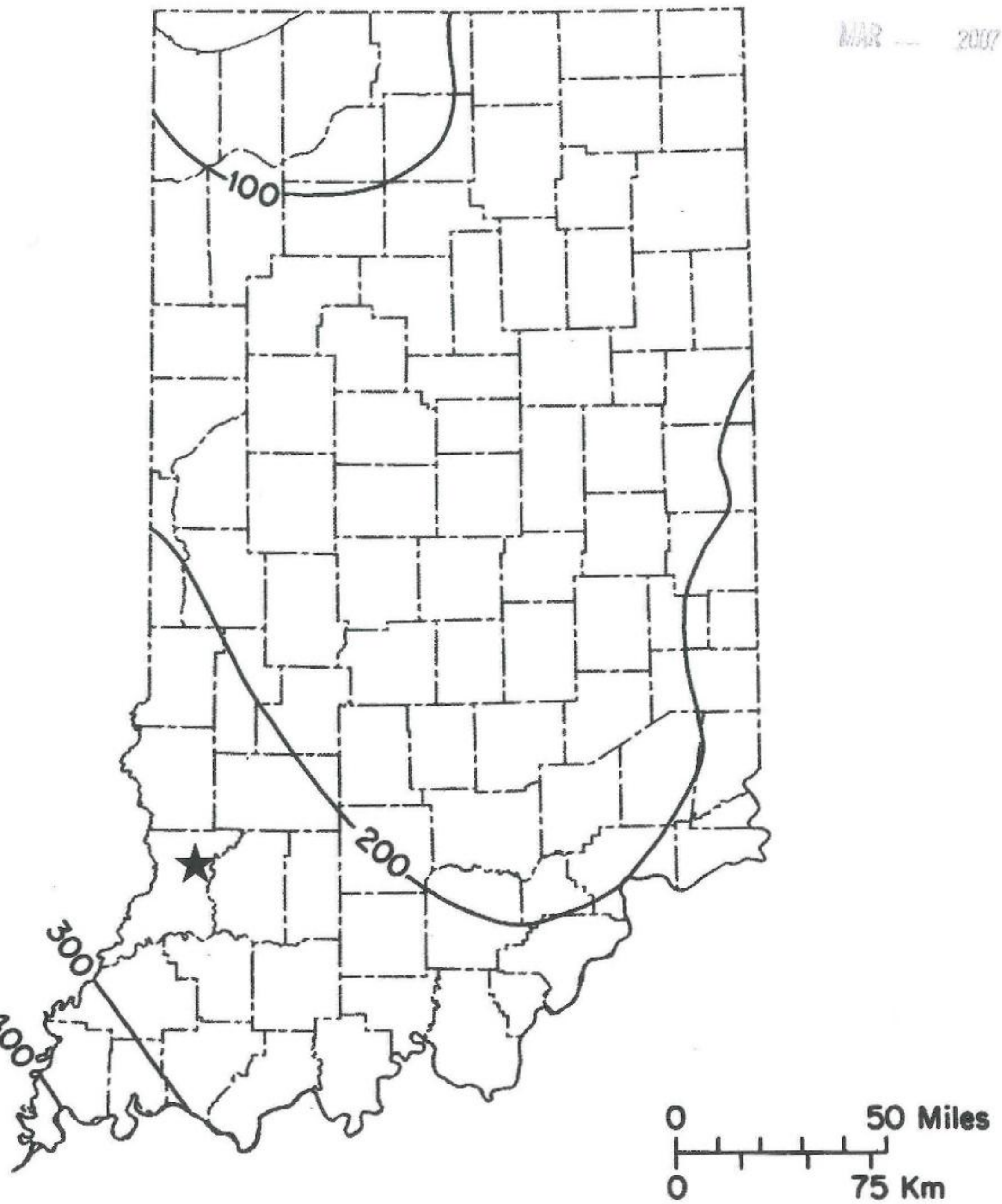
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE PLATTIN FORMATION

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–9

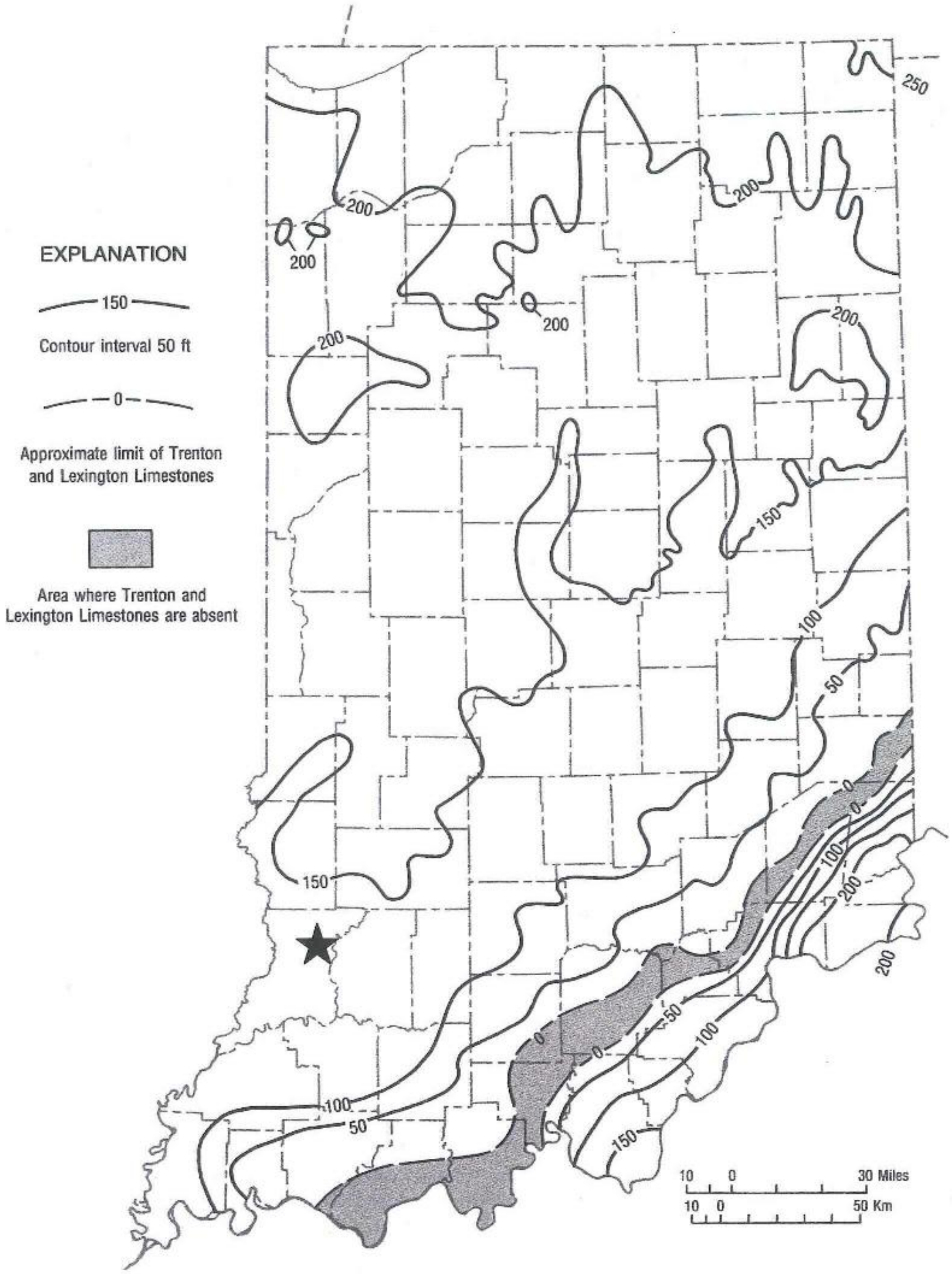
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE PLATTIN FORMATION

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE, ABDULKAREEM, AND PATTON, 1982



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–10

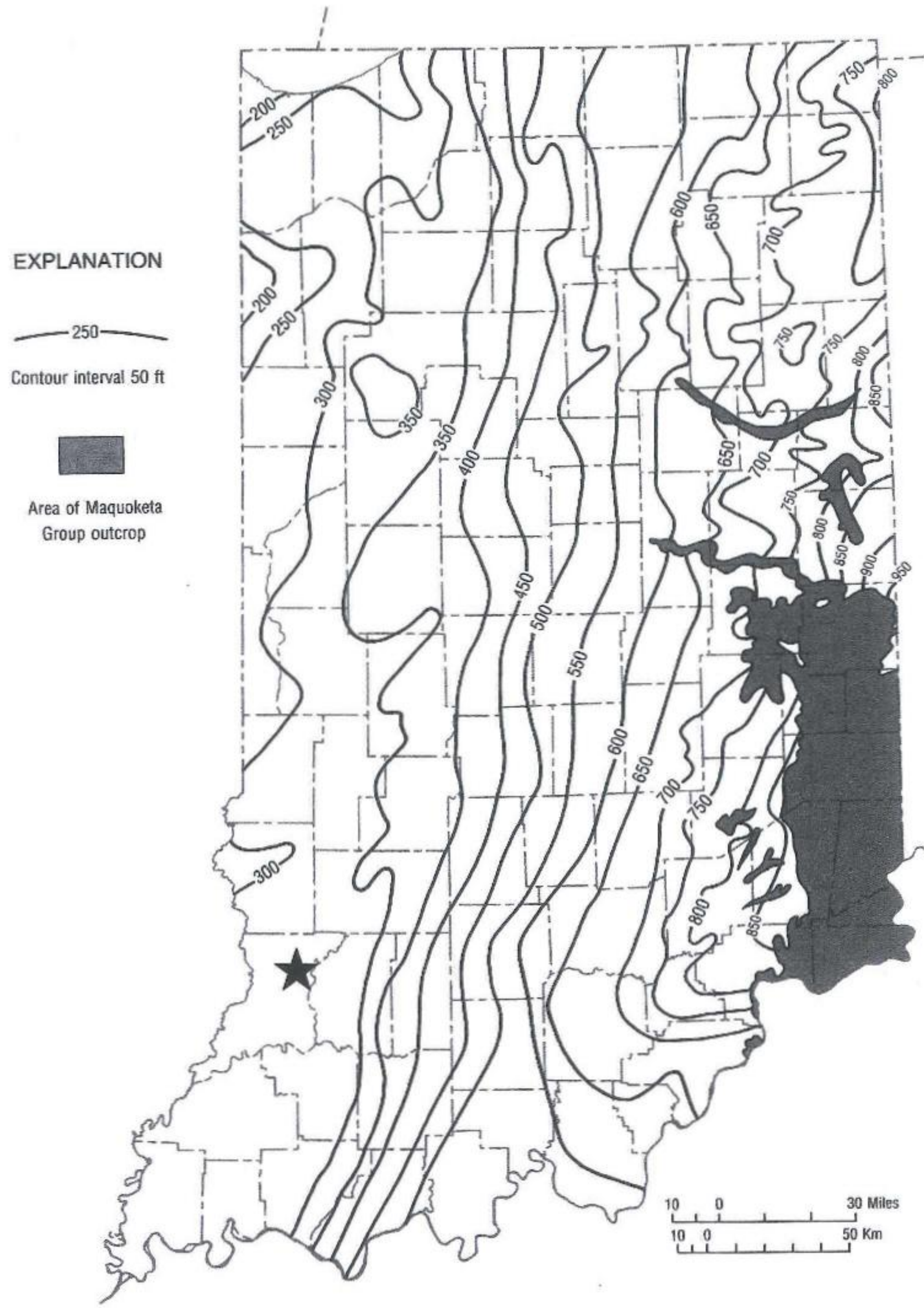
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE TRENTON AND LEXINGTON LIMESTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–11
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF INDIANA SHOWING
THICKNESS OF THE MAQUOKETA GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991

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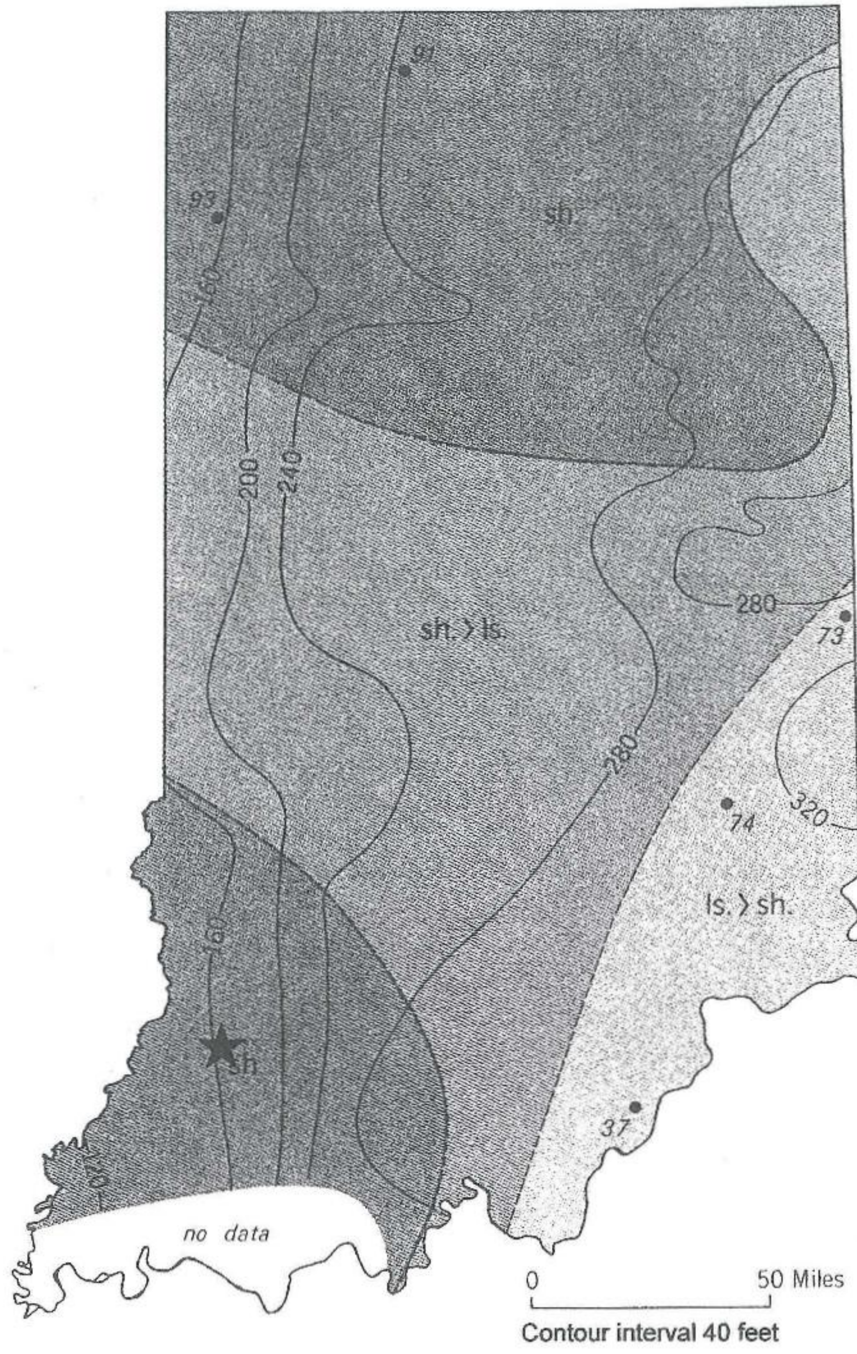


LEGEND

★ SITE LOCATION

LITHOFACIES INTERPRETATION IS ESTIMATED FROM CHIP SAMPLE STUDIES. LOCATION OF CORE HOLES IS SHOWN WITH FIGURES GIVING PERCENT OF TERRIGENOUS CLASTIC ROCKS IN INTERVAL AS DETERMINED FROM CORE MEASUREMENTS.

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–12

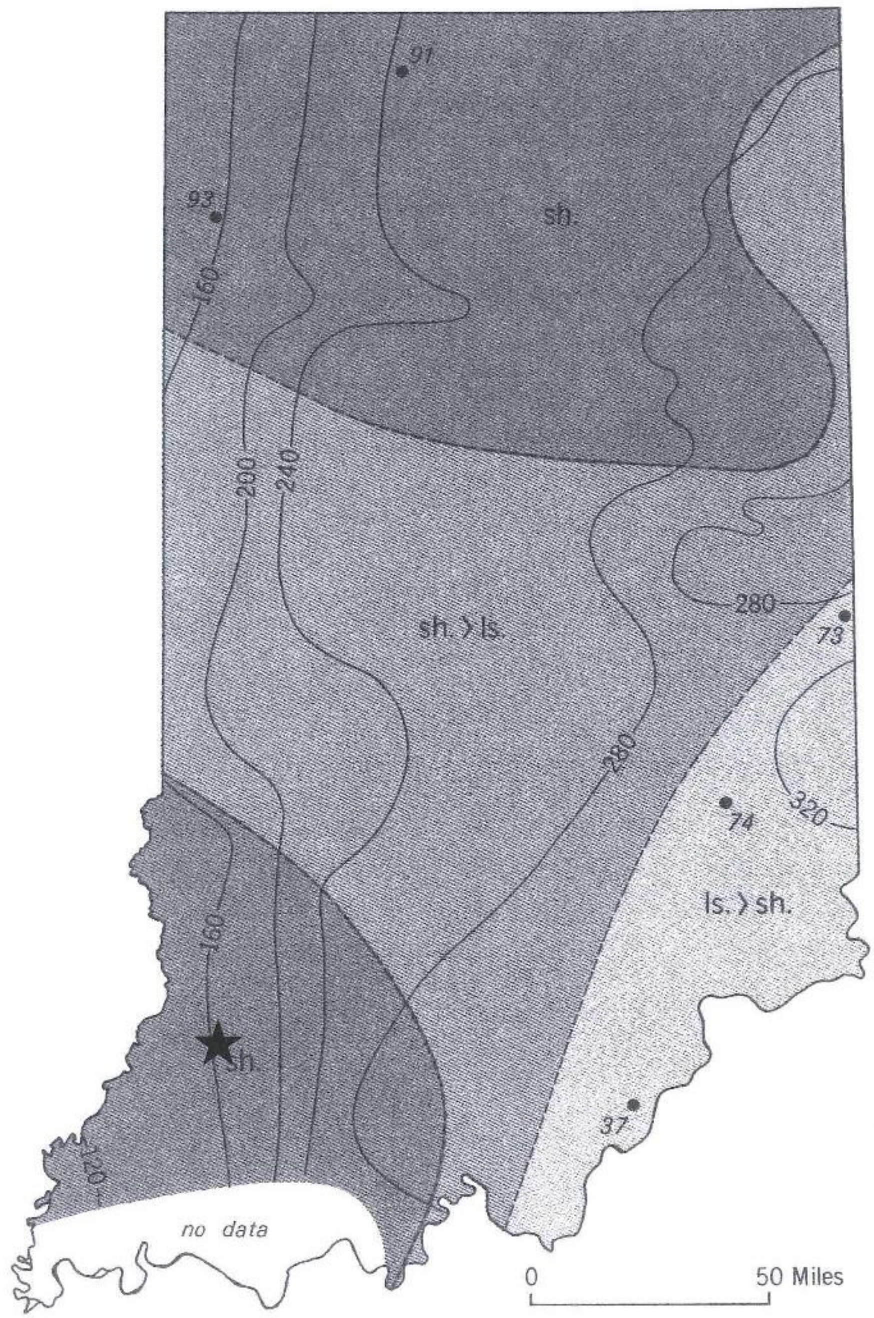
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS AND LITHOFACIES INTERPRETATIONS OF UNIT B, MAQUOKETA GROUP

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: GRAY, 1972



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–12

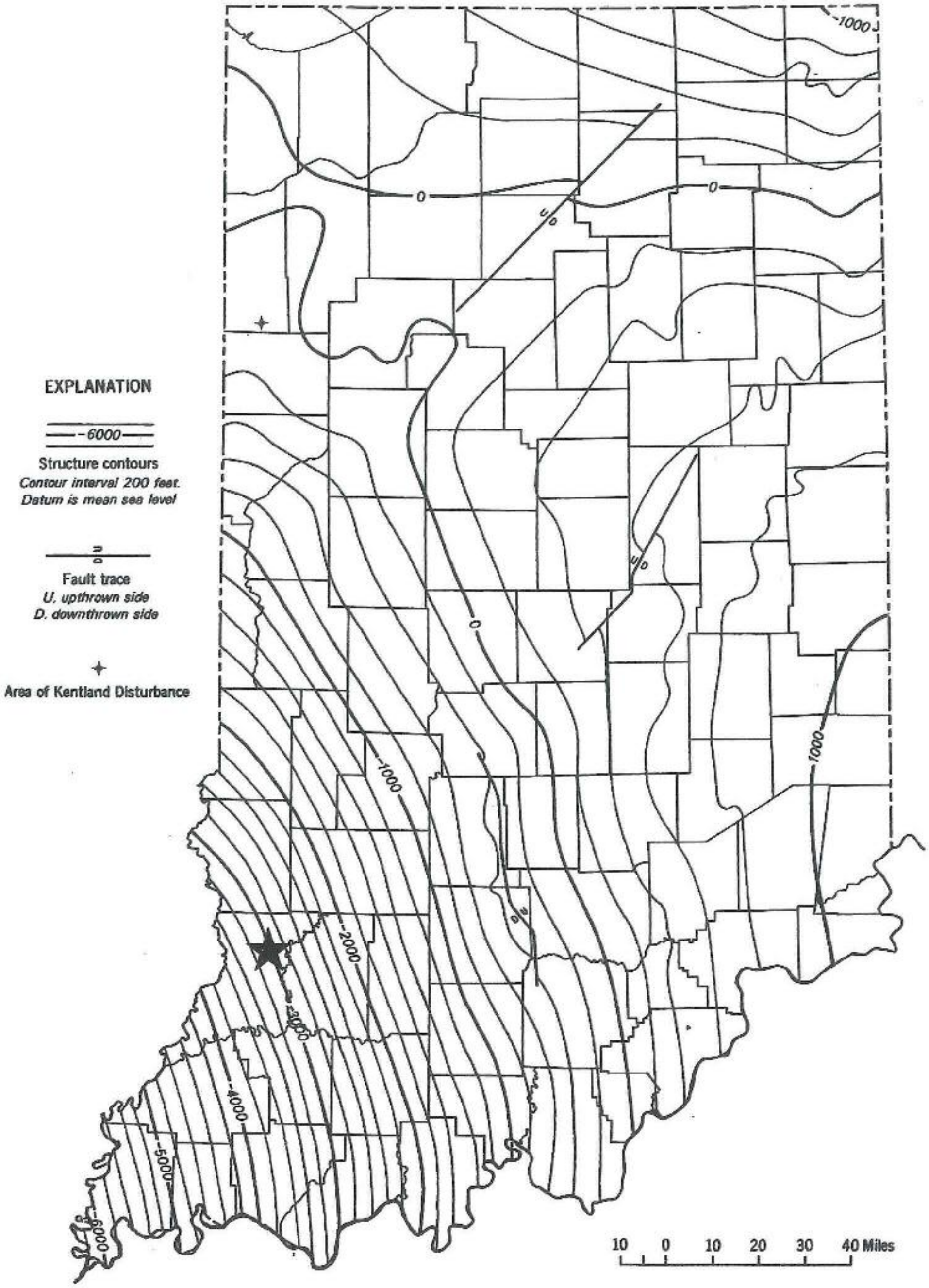
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS AND LITHOFACIES INTERPRETATIONS OF UNIT B, MAQUOKETA GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: GRAY, 1972



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.3–13

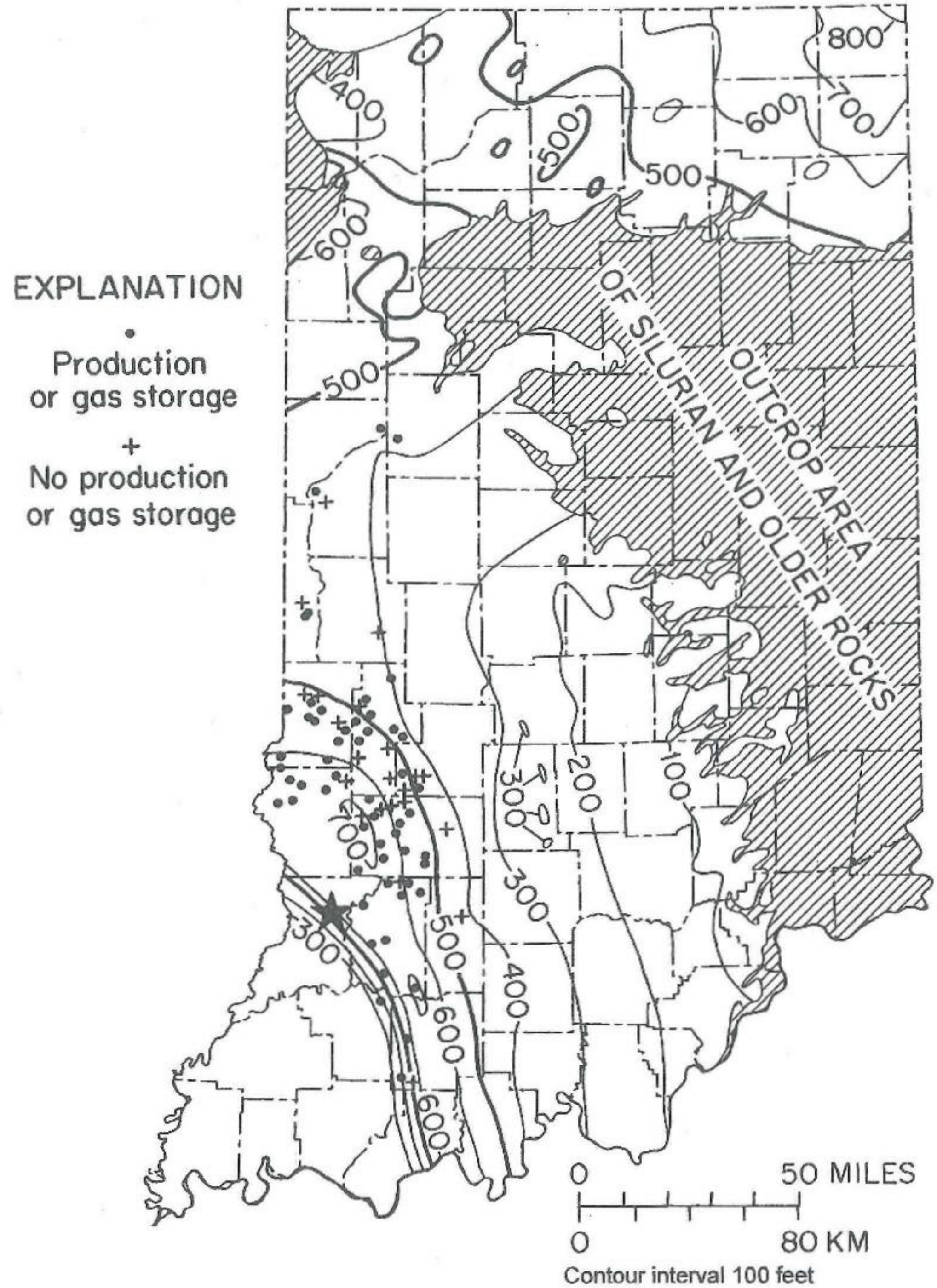
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE MAQUOKETA GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: GRAY, 1972



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LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.4-1

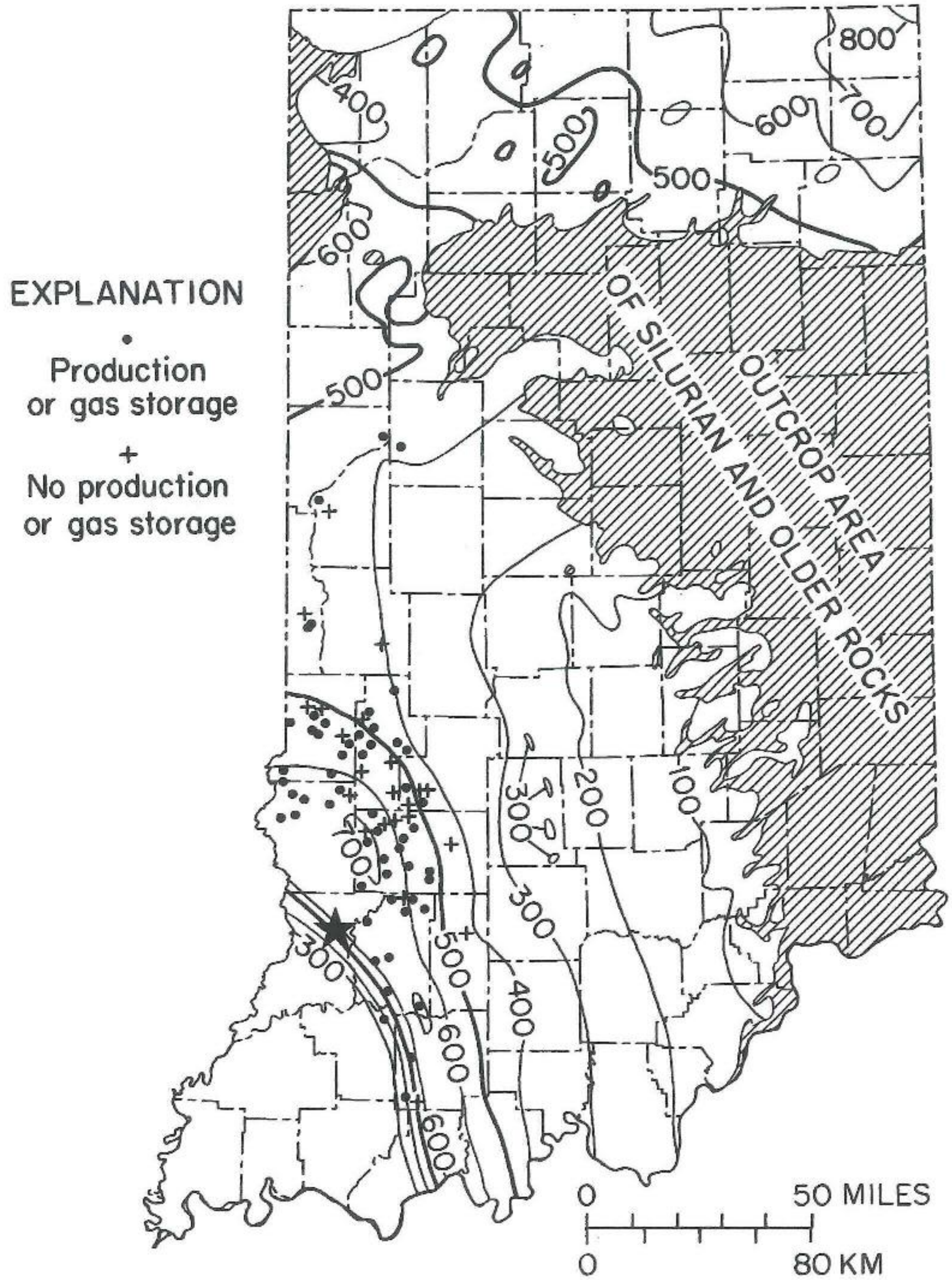
DUKE ENERGY

EDWARDSPORT FACILITY

ISOPACH MAP OF THE SILURIAN SYSTEM AND LOCATION OF REEFS IN SOUTHWESTERN INDIANA

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: BECKER AND KELLER, 1976



MAR - - 2007

LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUCE, LA.

FIGURE F.2.4-1

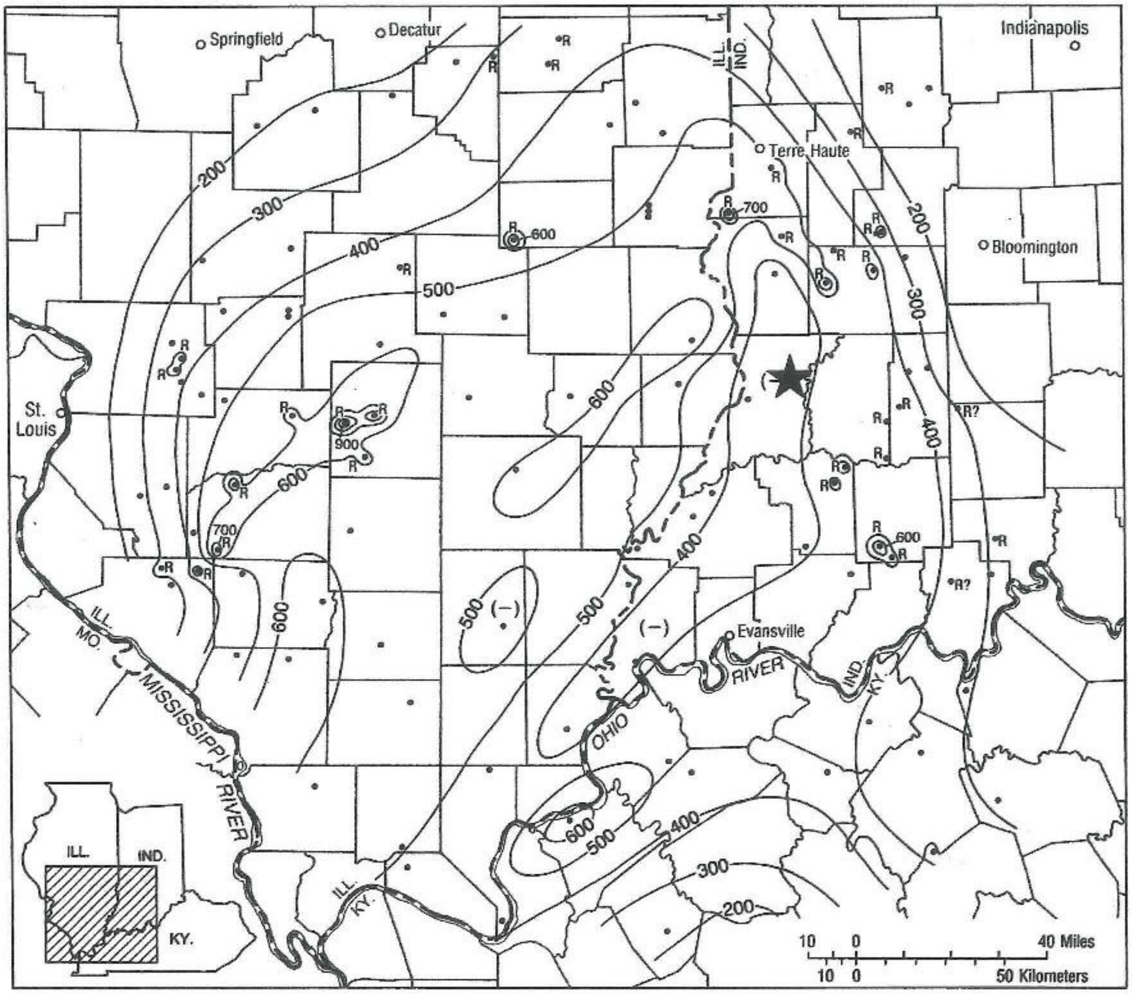
DUKE ENERGY

EDWARDSPORT FACILITY

ISOPACH MAP OF THE SILURIAN SYSTEM AND LOCATION OF REEFS IN SOUTHWESTERN INDIANA

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: BECKER AND KELLER, 1976



LEGEND

★ SITE LOCATION

R INDICATES WELLS THAT PENETRATE REEFS AND THAT MAY YIELD THICKNESSES GREATER THAN REGIONAL THICKNESSES.
CONTOUR INTERVAL IS 100 FEET.

N

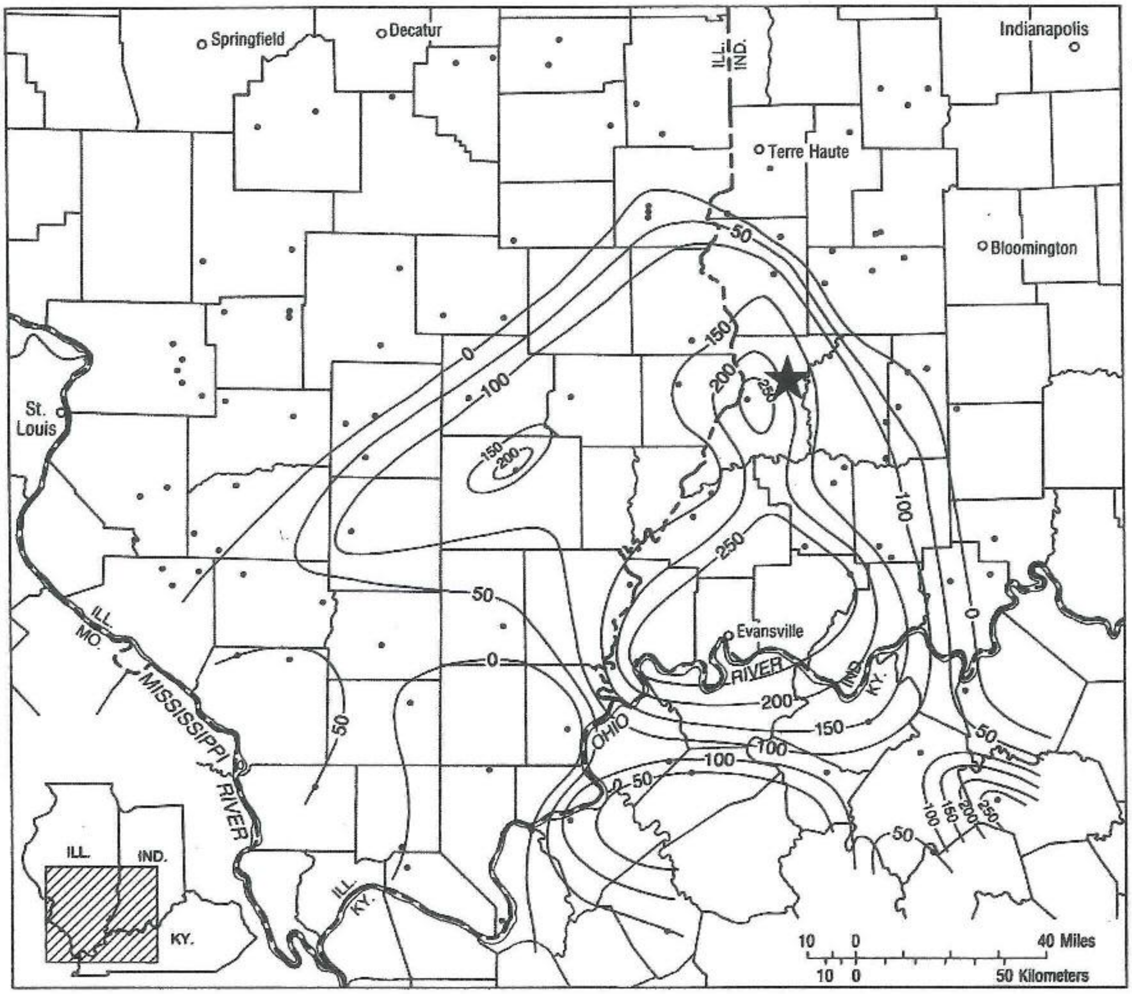
SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.4–2
DUKE ENERGY
EDWARDSPORT FACILITY
MAP SHOWING THICKNESS OF THE MOCCASIN SPRINGS AND BAILEY LIMESTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND SHAVER, 1987



LEGEND

★ SITE LOCATION

CONTOUR INTERVAL IS 50 FEET

N

SOURCE: DROSTE AND SHAVER, 1987

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

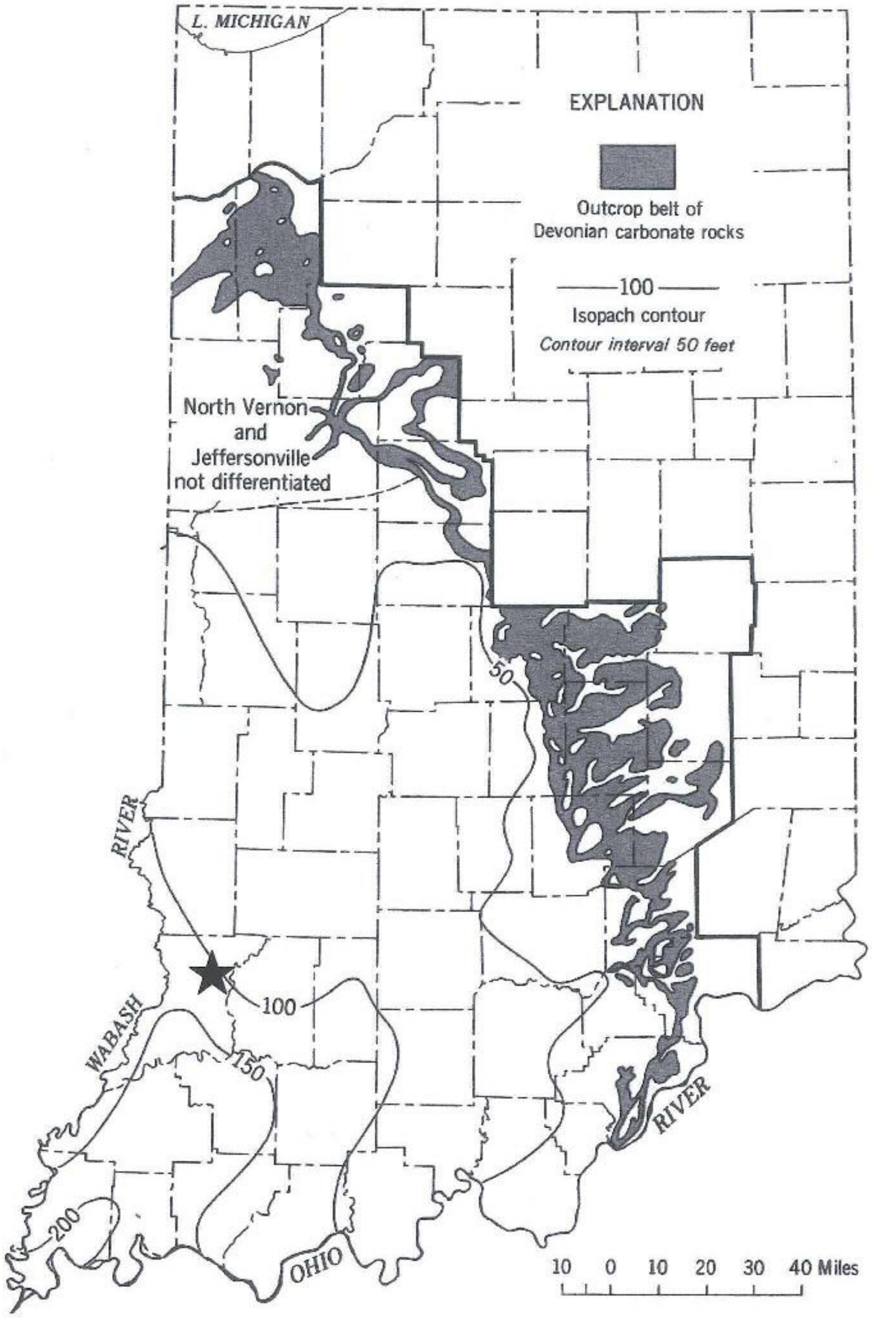
FIGURE F.2.5–1

DUKE ENERGY

EDWARDSPORT FACILITY

MAP SHOWING THICKNESS OF THE BACKBONE LIMESTONE IN THE ILLINOIS BASIN

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SOURCE: BECKER, 1974

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

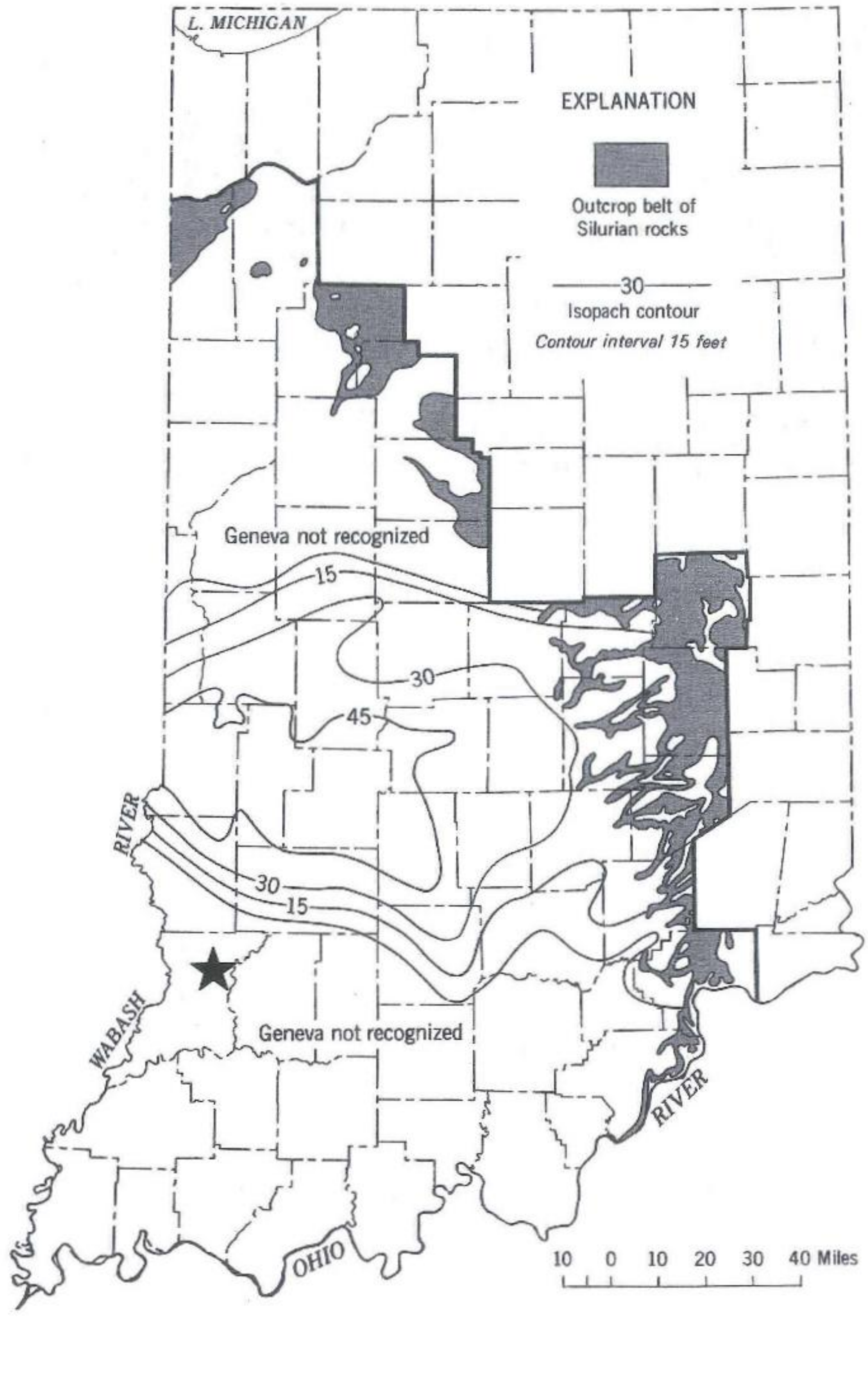
FIGURE F.2.5–2

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE JEFFERSONVILLE LIMESTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60Z5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SOURCE: BECKER, 1974

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

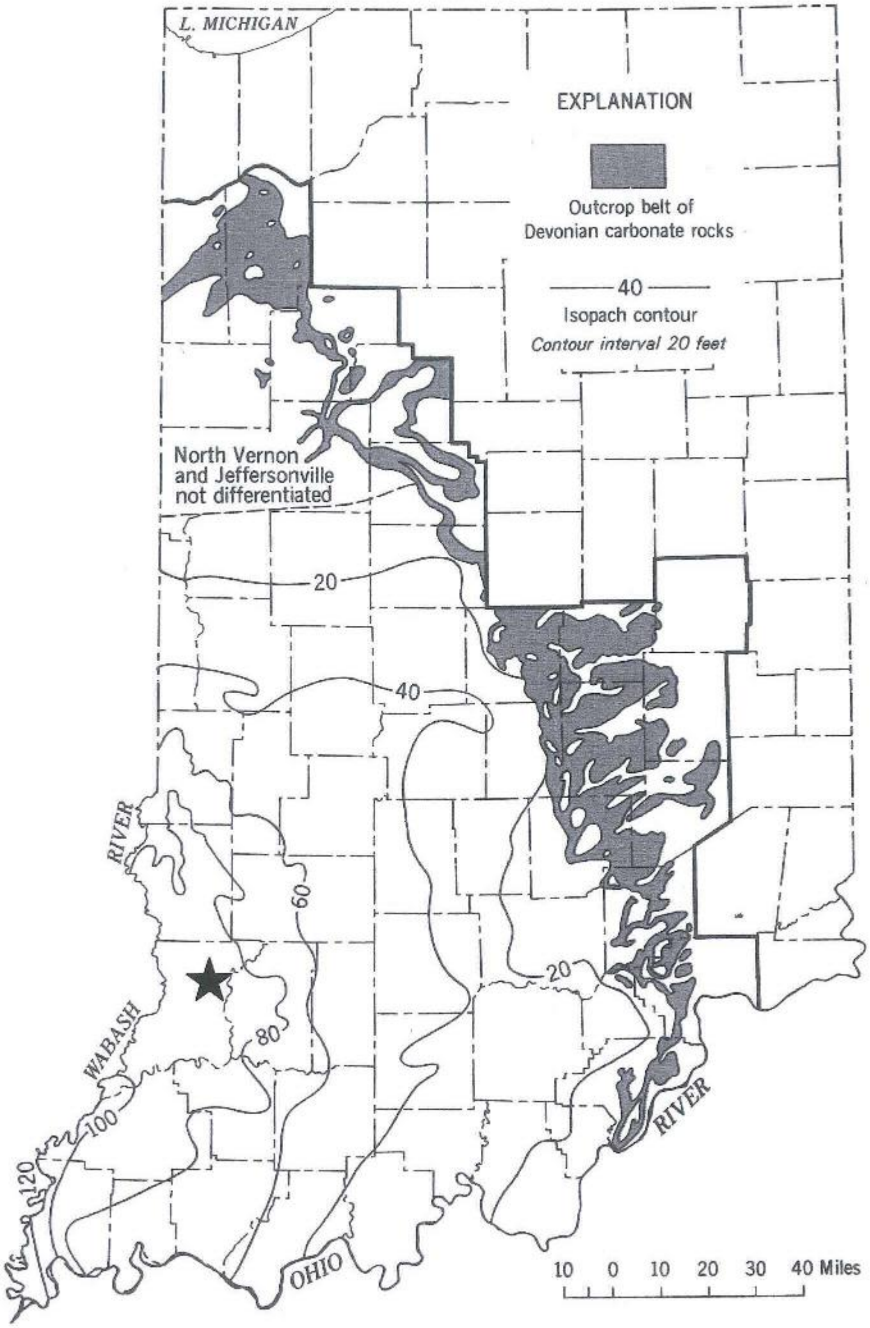
FIGURE F.2.5–3

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE GENEVA DOLOMITE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.5–4

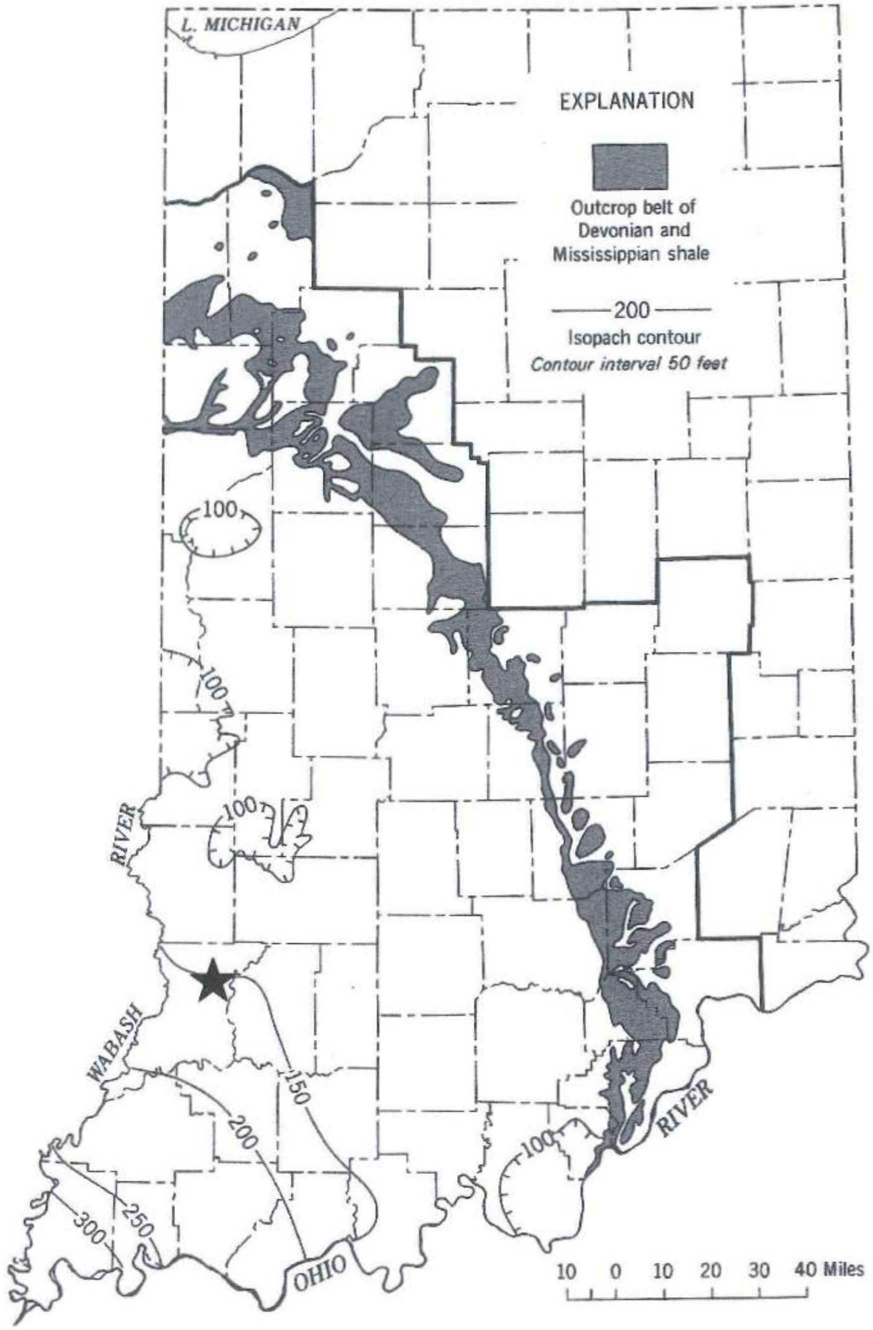
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE NORTH VERNON LIMESTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: BECKER, 1974



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.5–5

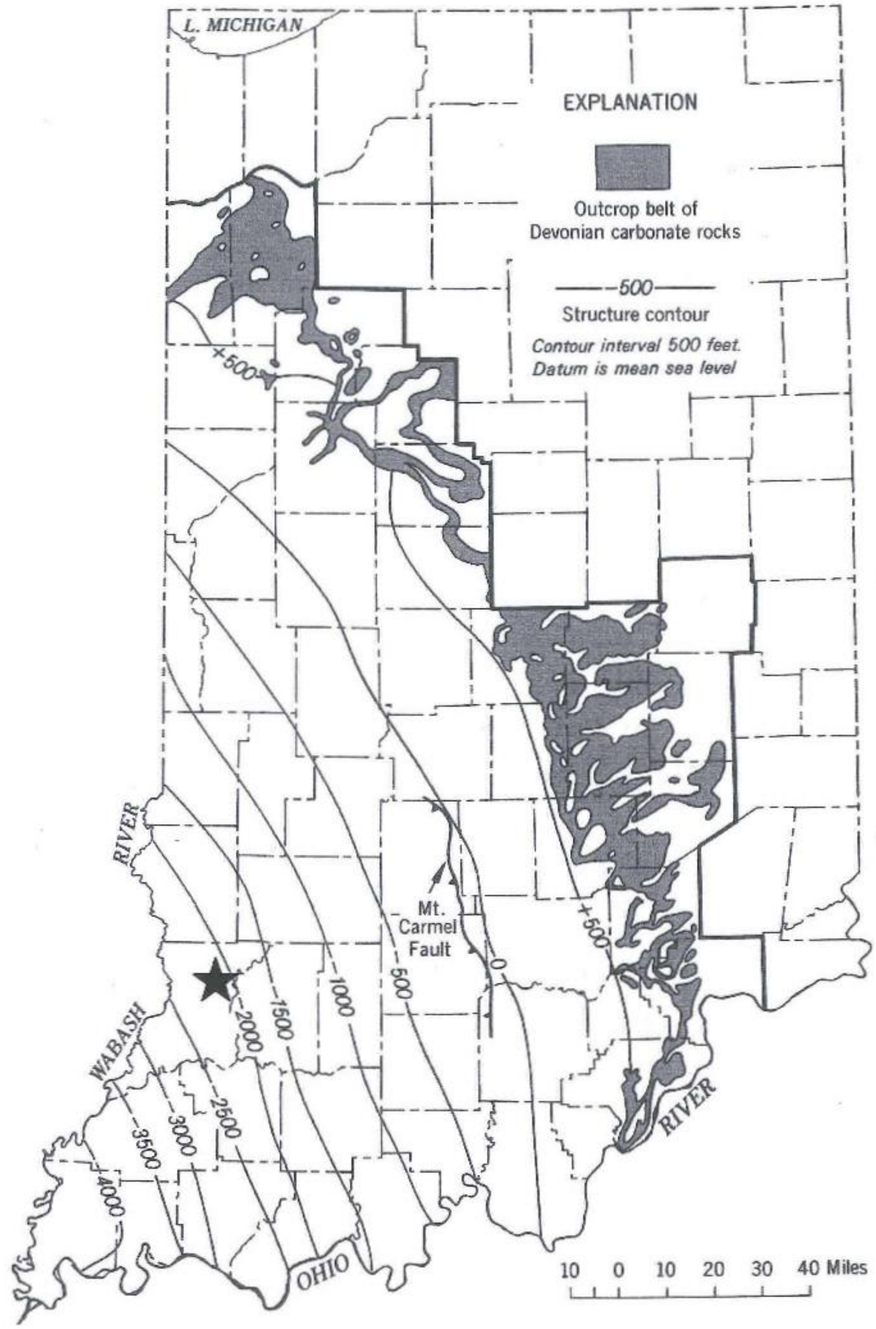
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE NEW ALBANY SHALE

DATE: 12/11/06	CHECKED BY: RJS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: BECKER, 1974



LEGEND

★ SITE LOCATION

SOURCE: BECKER, 1974

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.5–6

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON BASE OF THE NEW ALBANY SHALE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

EXPLANATION

PENNSYLVANIAN

P3 — McLeansboro Group
Shale, sandstone, limestone, and thin coal

P2 — Carbondale Group
Shale, sandstone, limestone, clay, and coal

P1 — Raccoon Creek Group
Shale, sandstone, limestone, clay, and coal

MISSISSIPPIAN

M3 — West Baden and Stephensport Groups and unnamed upper Chesterian Group
Shale, sandstone, and limestone

M2 — Sanders and Blue River Groups
Limestone

M1 — Rockford Limestone and Borden Group (south); Coldwater Shale (north)
Siltstone, shale, and thin limestone

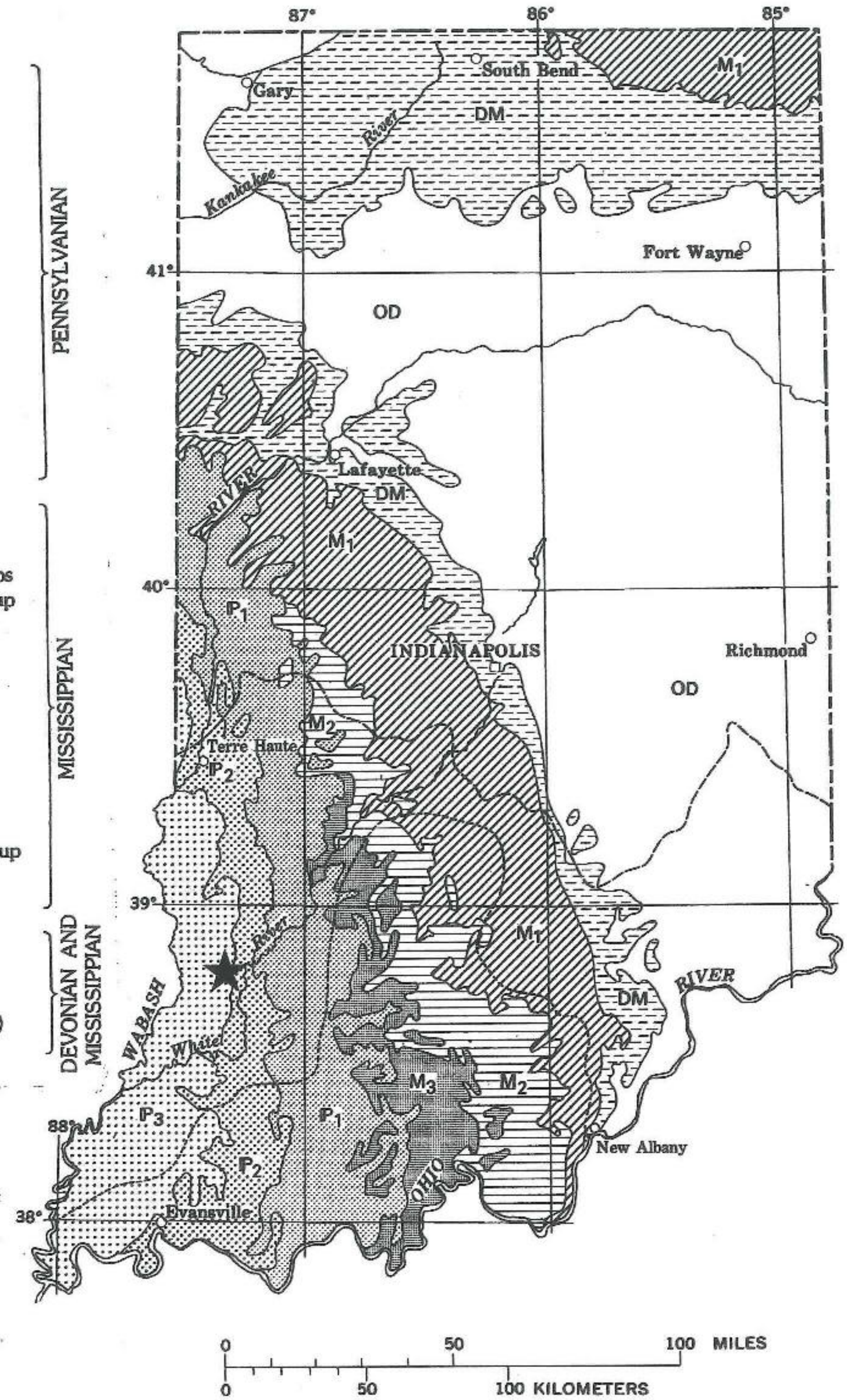
DEVONIAN AND MISSISSIPPIAN

DM — New Albany Shale (south); Antrim and Ellsworth Shales (north)
Black and greenish-gray shale

OD — Ordovician, Silurian, and Middle Devonian rocks

———— Wisconsinan glacial boundary

- - - - - Boundary of older glaciations



LEGEND

★ SITE LOCATION

N

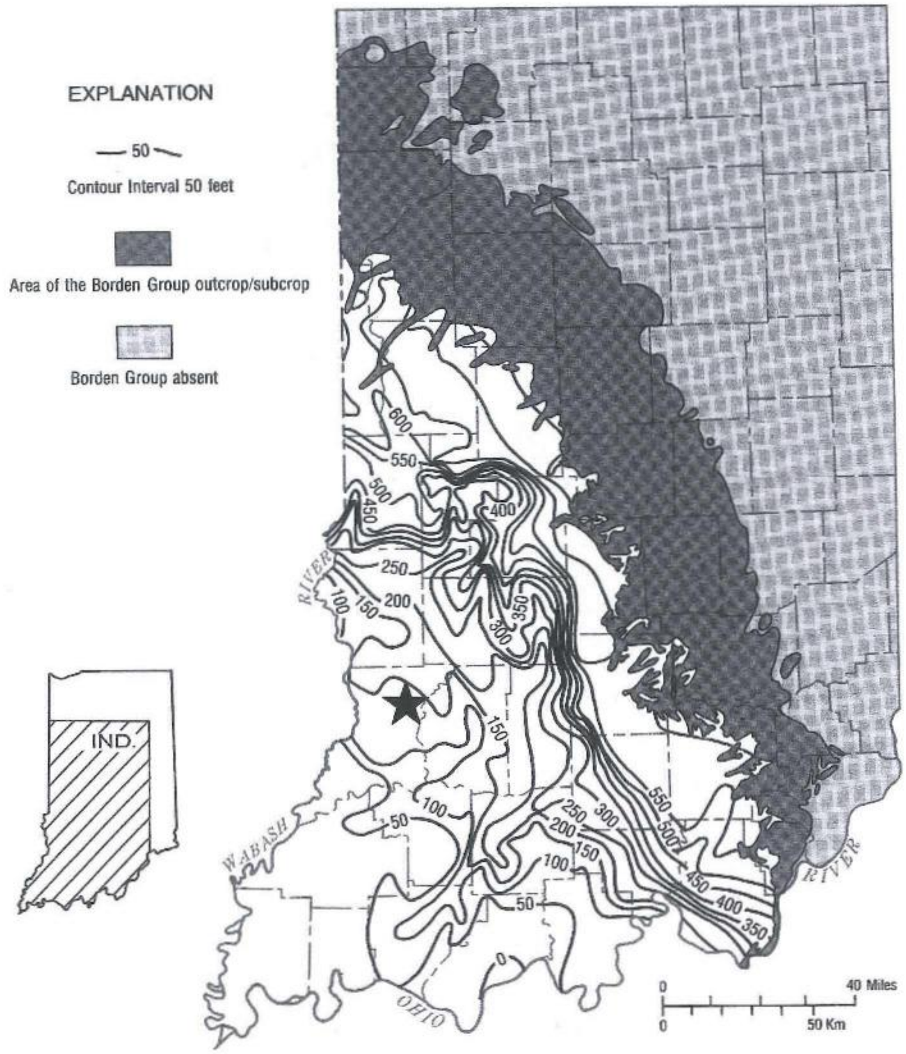
SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6-1
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF INDIANA SHOWING THE DISTRIBUTION OF MISSISSIPPIAN AND PENNSYLVANIAN ROCKS

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: GRAY, 1979



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6-2

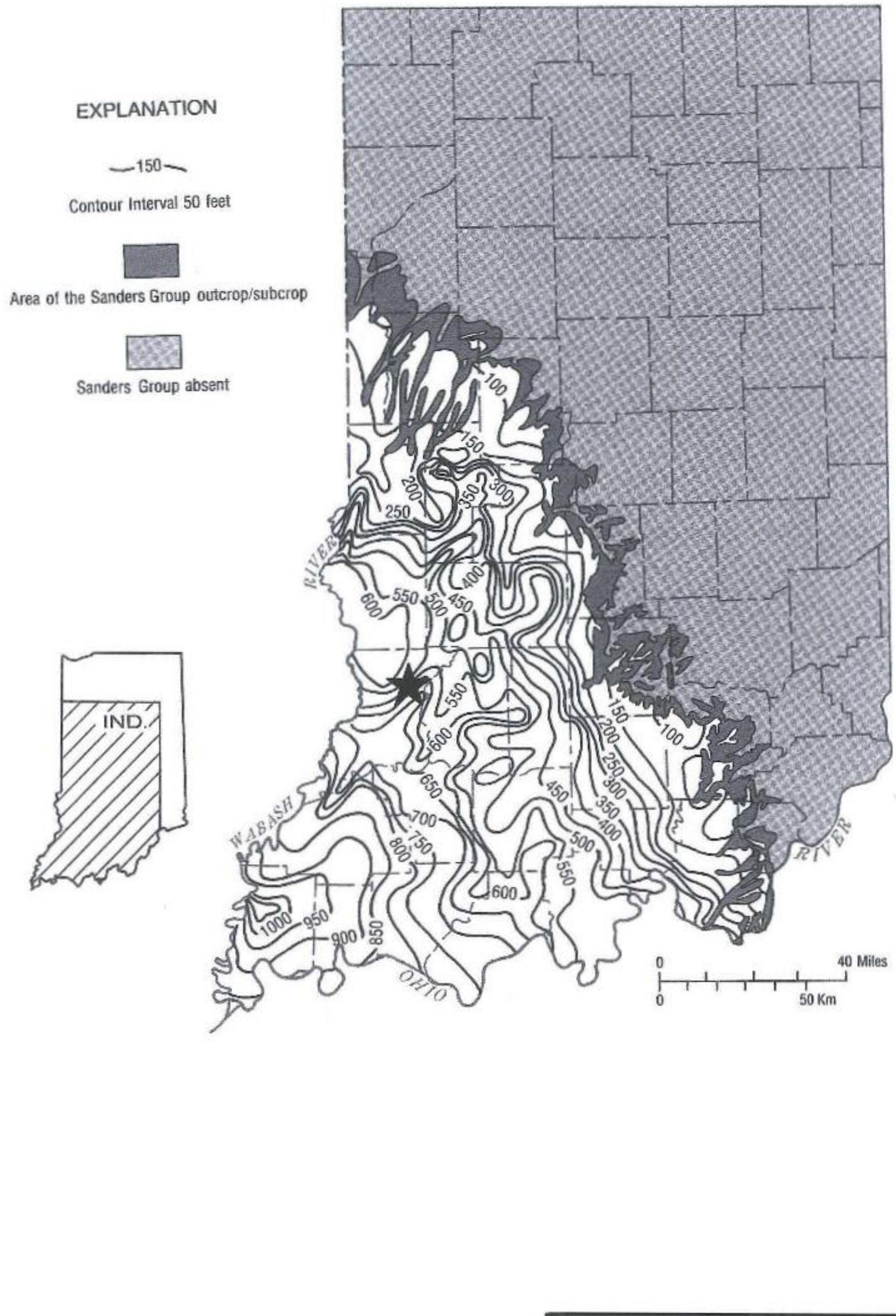
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE BORDEN GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



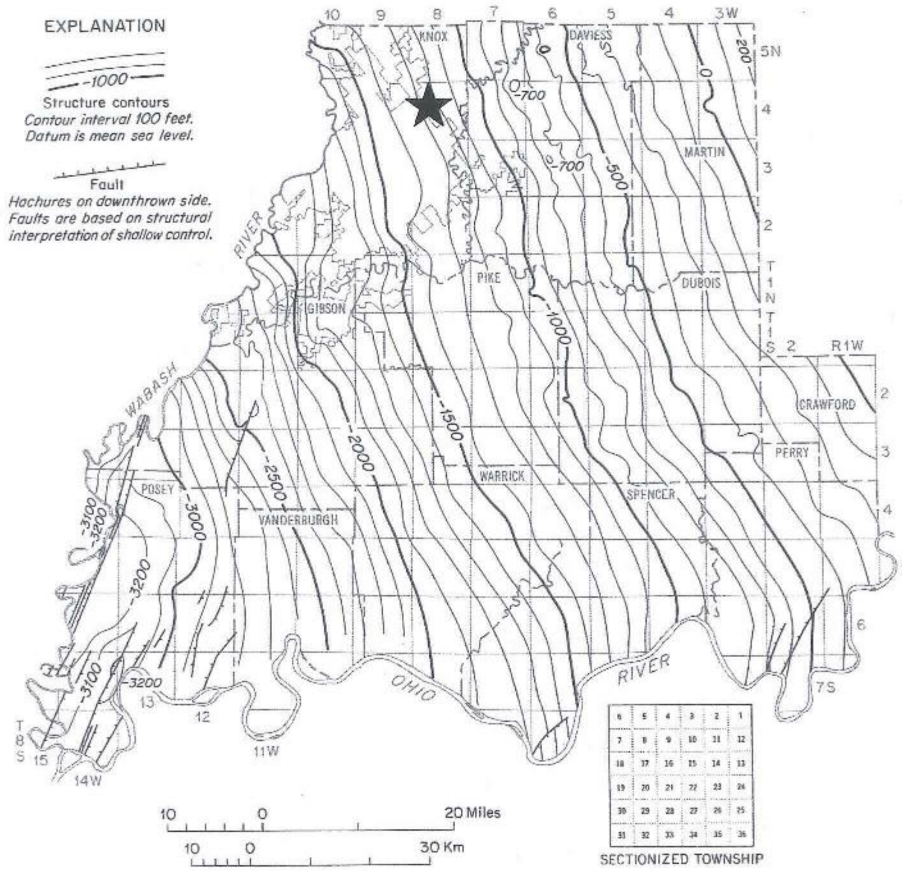
SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6–3
DUKE ENERGY
EDWARDSPORT FACILITY
MAP OF INDIANA SHOWING
THICKNESS OF THE SANDERS GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6–4

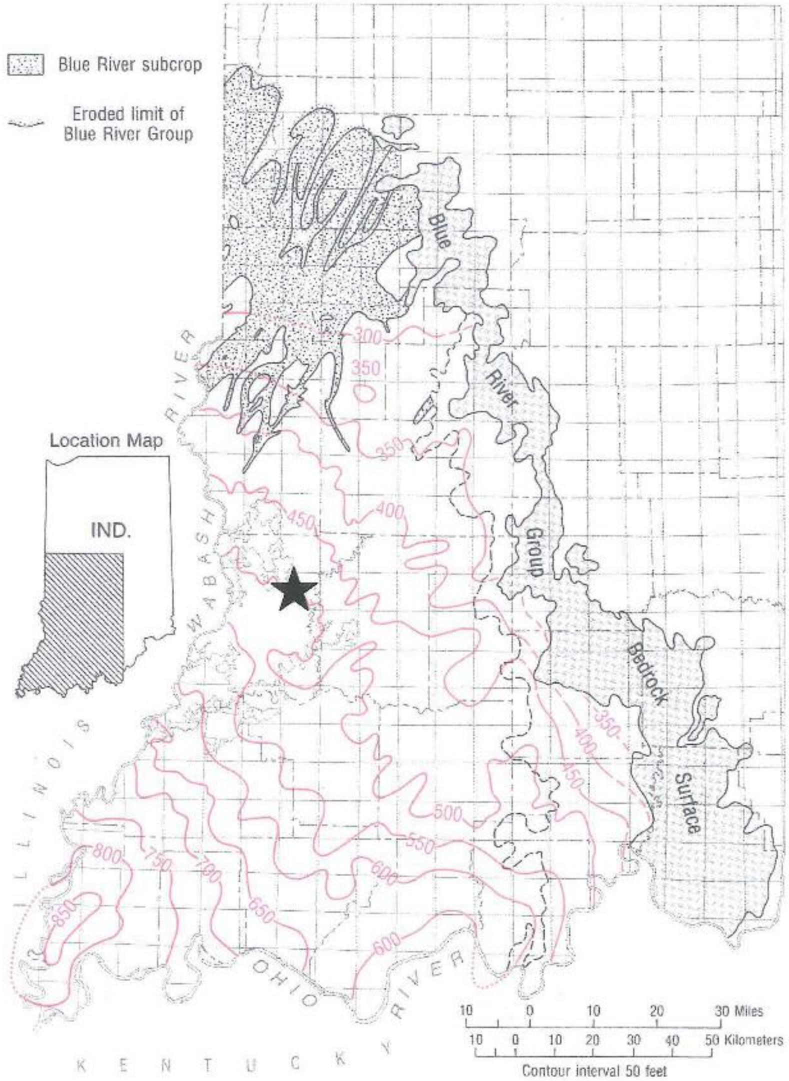
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE SALEM LIMESTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: KELLER AND BECKER, 1980



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6–5

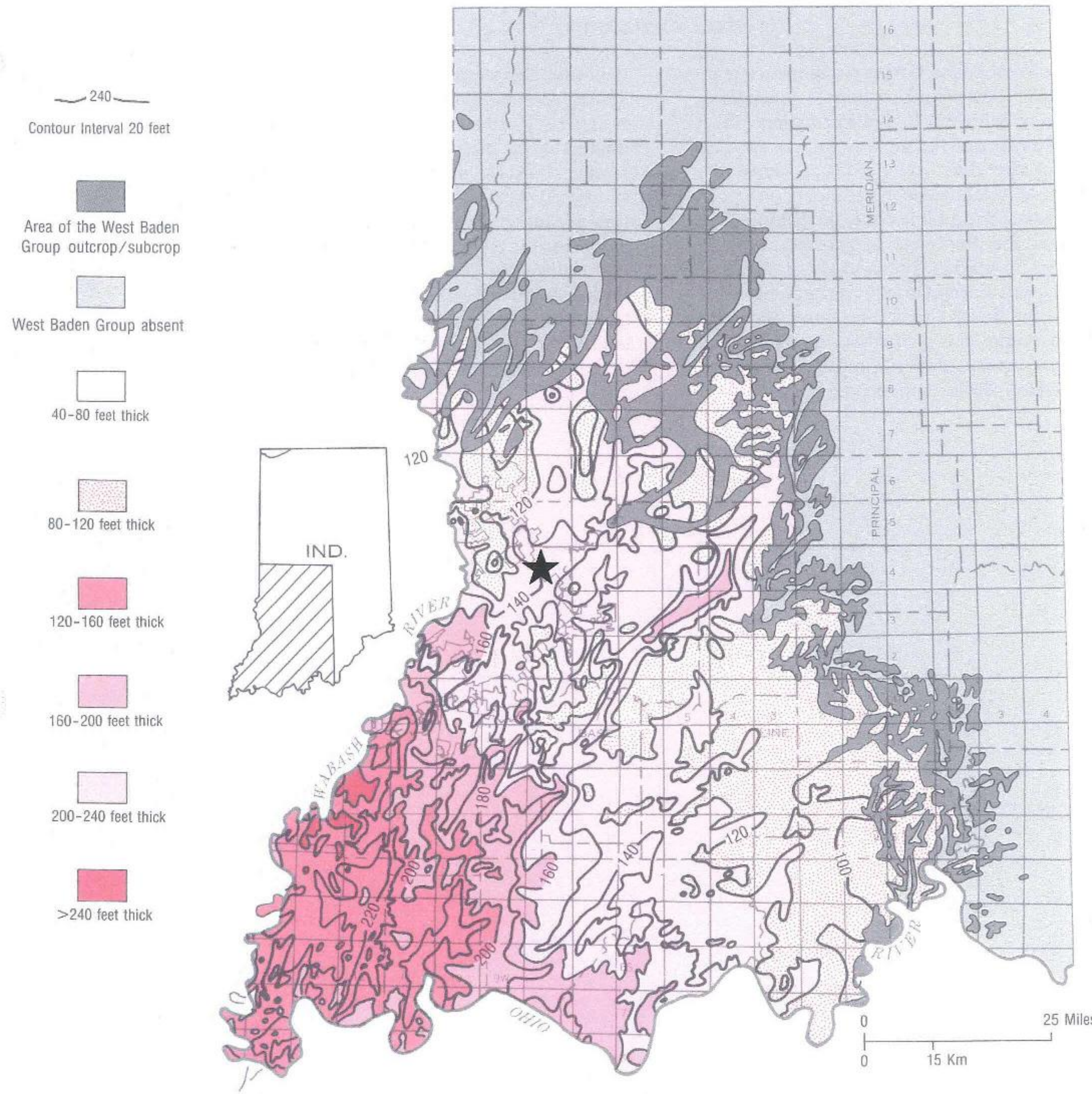
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE BLUE RIVER GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND CARPENTER, 1990



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6-6

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE WEST BADEN GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991

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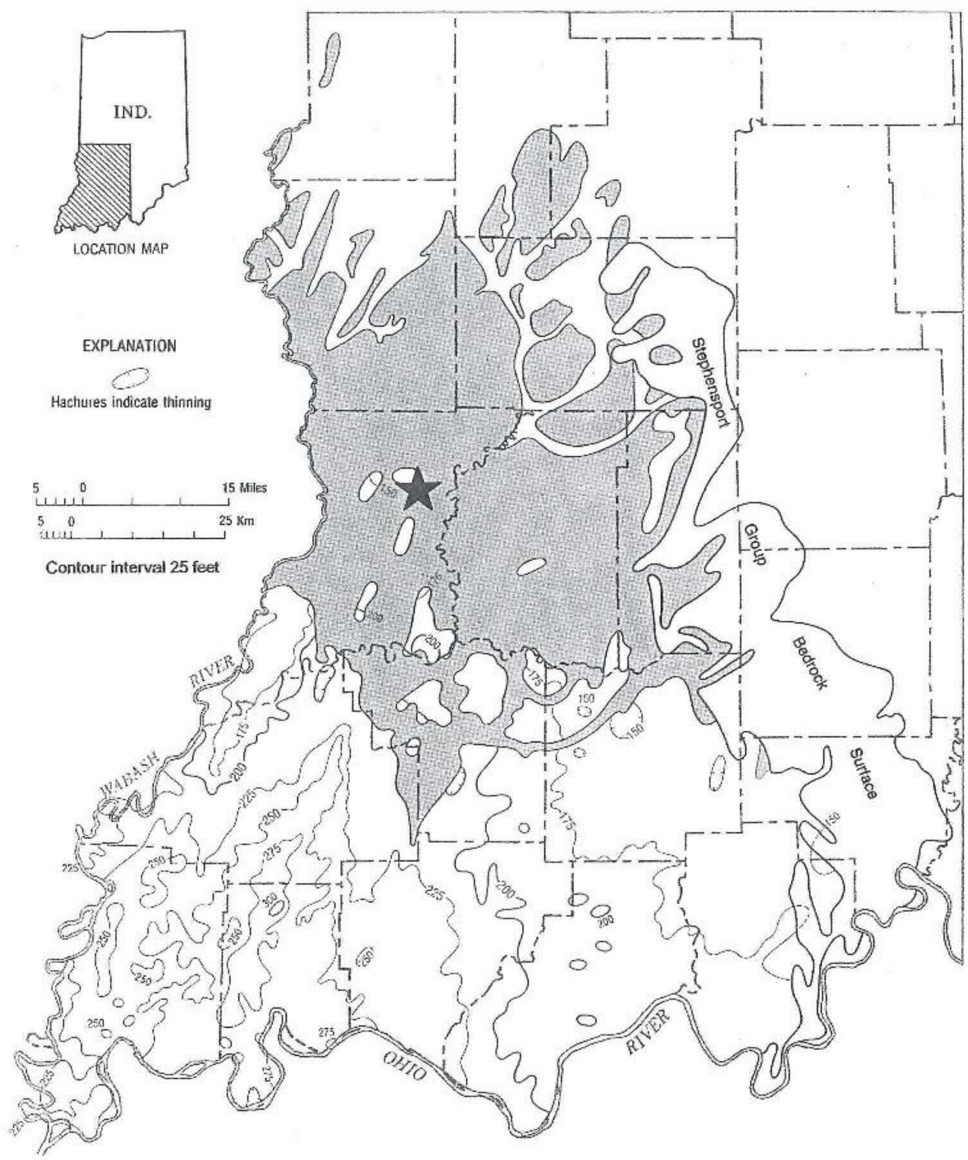

LEGEND

★ SITE LOCATION

SUBCROP OF STEPHENSPORT GROUP BENEATH PENNSYLVANIAN IS SHADED.

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6-7
DUKE ENERGY
EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING THICKNESS OF THE STEPHENSPORT GROUP

DATE: 3/13/08	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND KELLER, 1995

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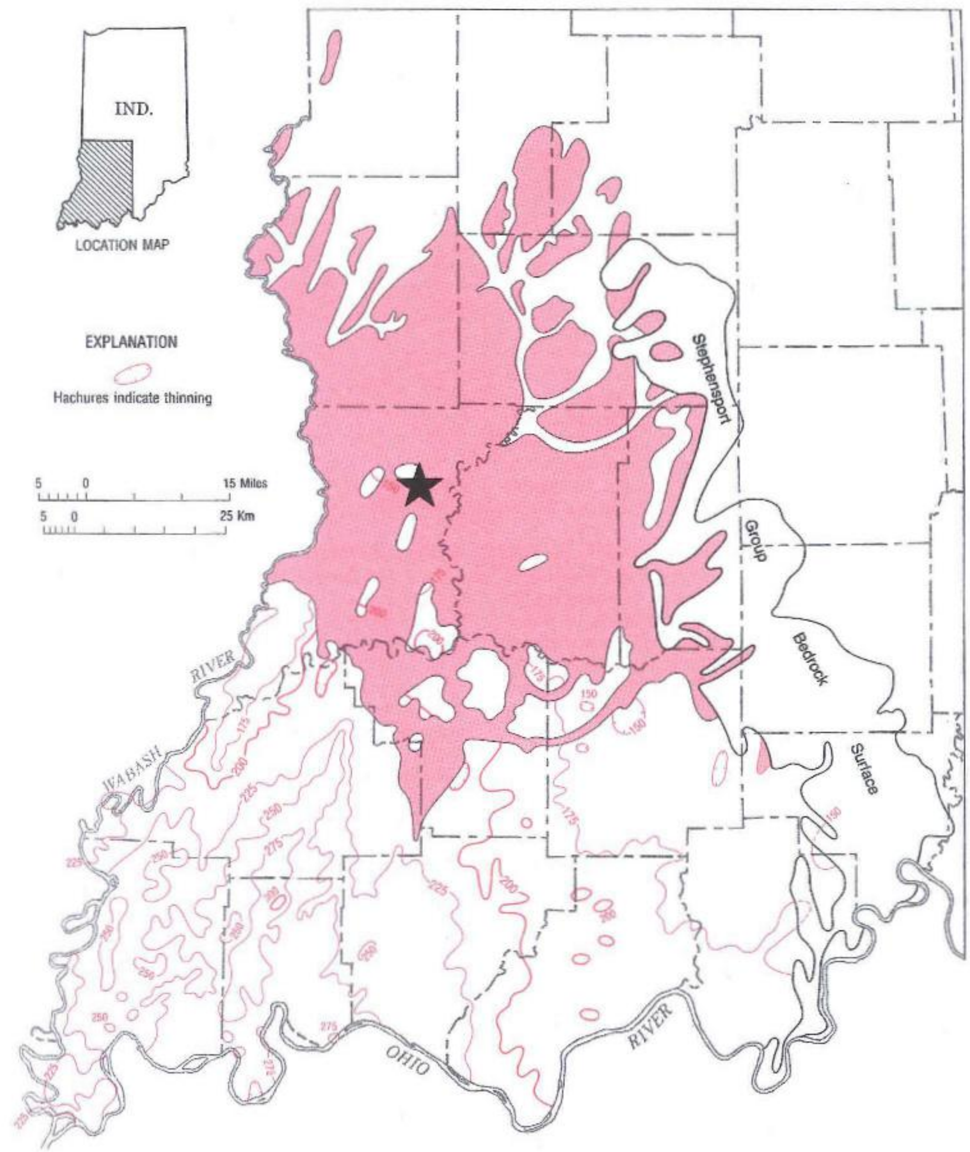


LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6-7

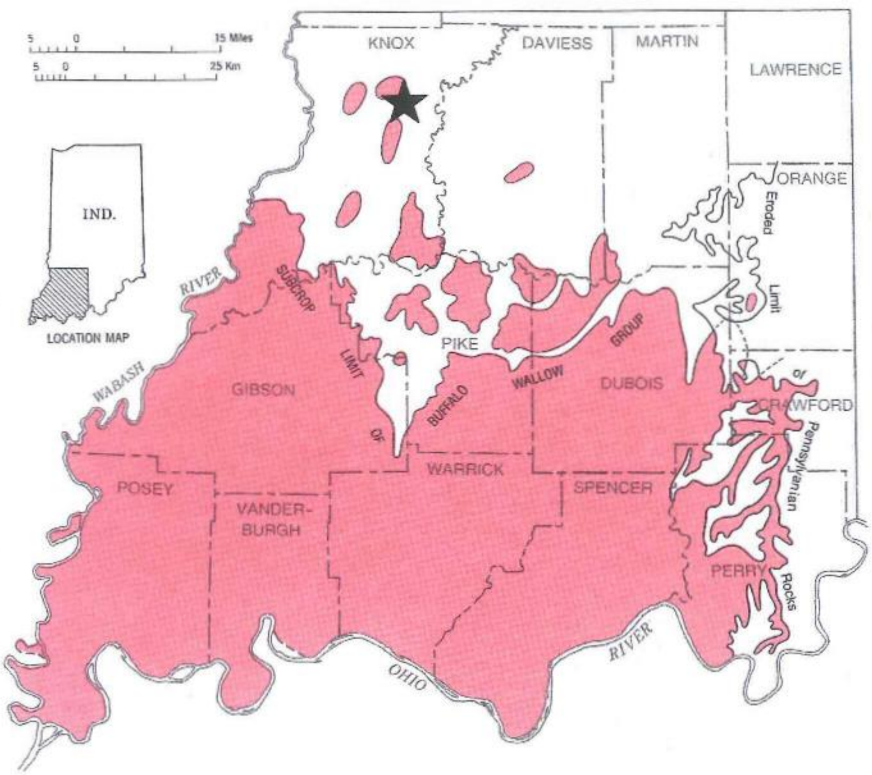
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE STEPHENSPORT GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND KELLER, 1995



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.6–8

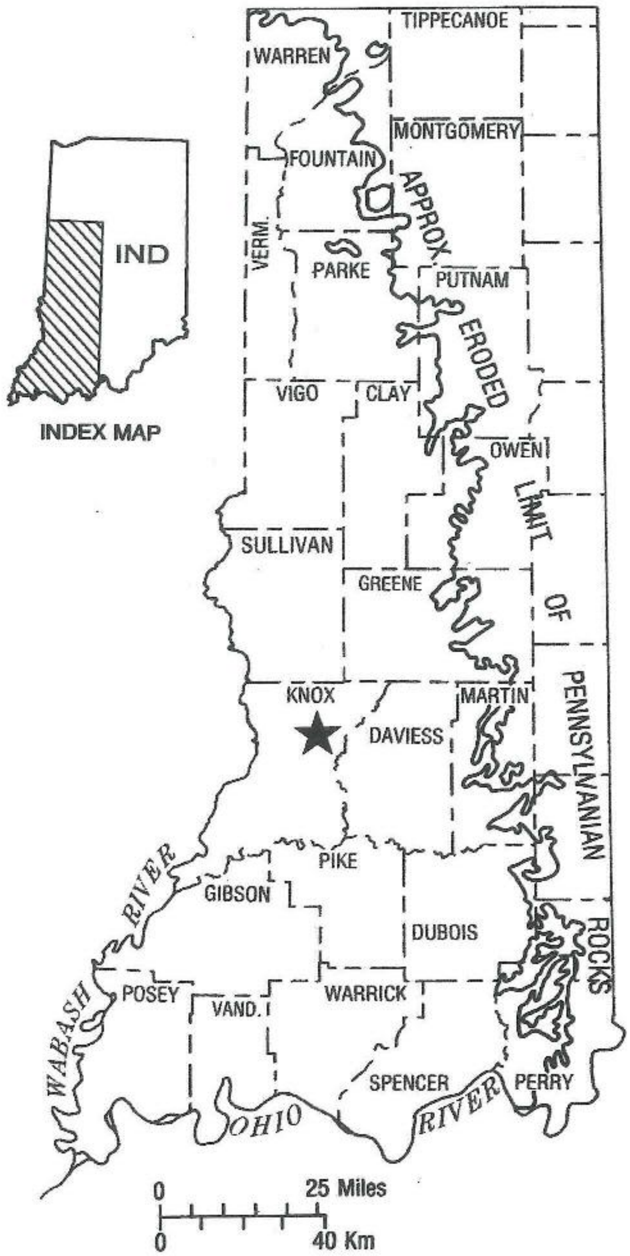
DUKE ENERGY

EDWARDSPORT FACILITY

MAP SHOWING THE ERODED LIMIT OF THE PENNSYLVANIAN SYSTEM AND THE SUBCROP LIMIT OF THE BUFFALO WALLOW GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND KELLER, 1995



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.7-1

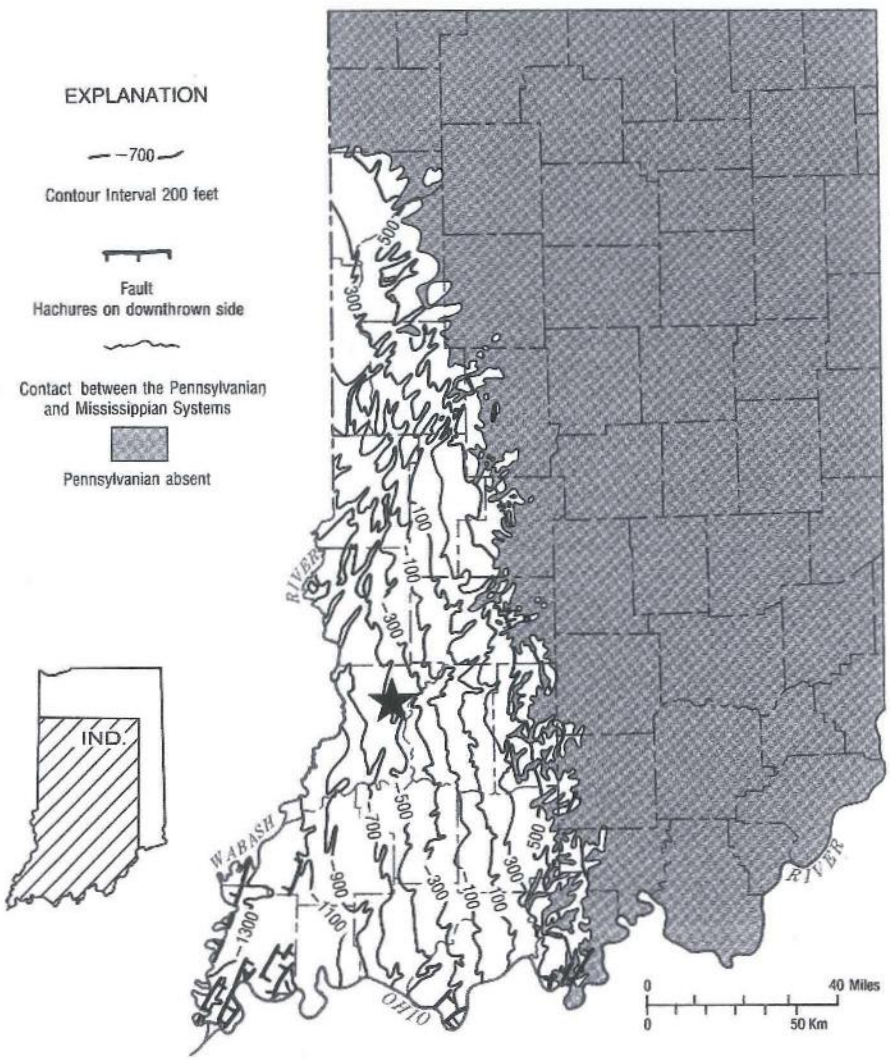
DUKE ENERGY

EDWARDSPORT FACILITY

MAP SHOWING APPROXIMATE ERODED LIMIT OF PENNSYLVANIAN ROCKS IN INDIANA

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: DROSTE AND KELLER, 1989



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.7-2

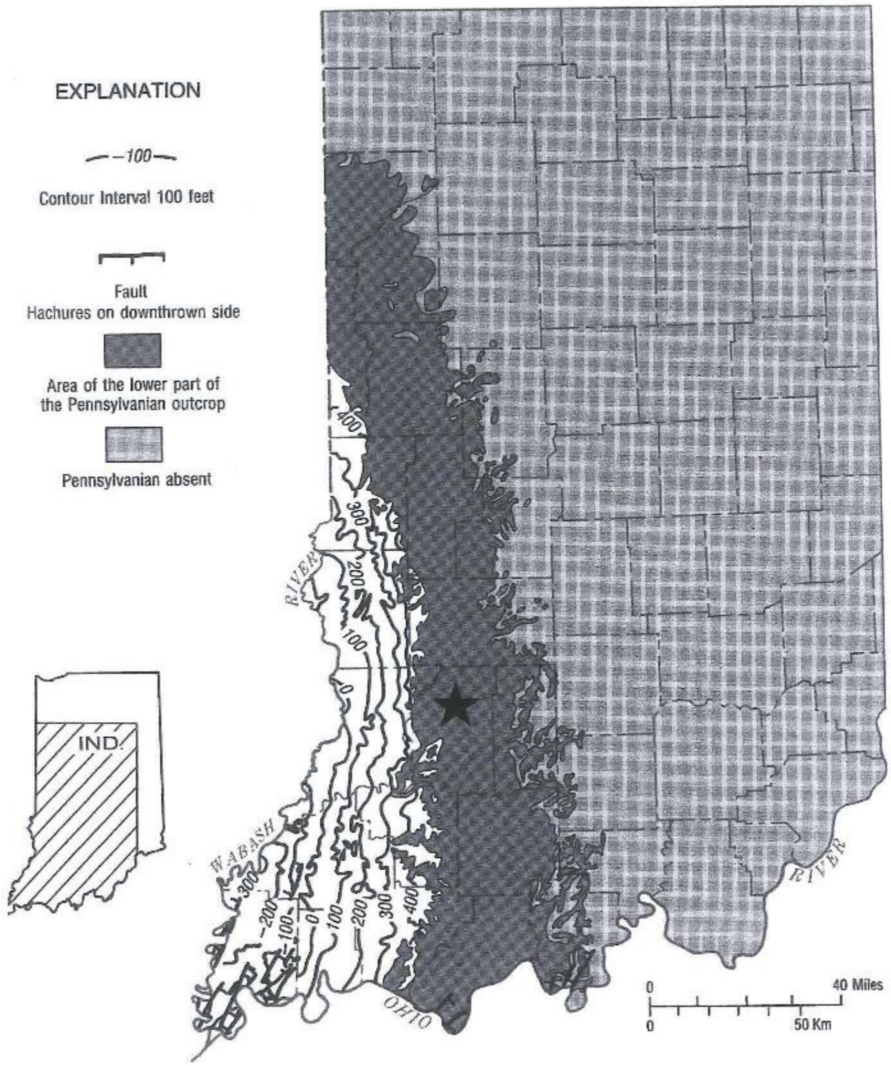
DUKE ENERGY

EDWARDSPORT FACILITY

MAP SHOWING STRUCTURE ON THE BASE OF THE PENNSYLVANIAN SYSTEM

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.7–3

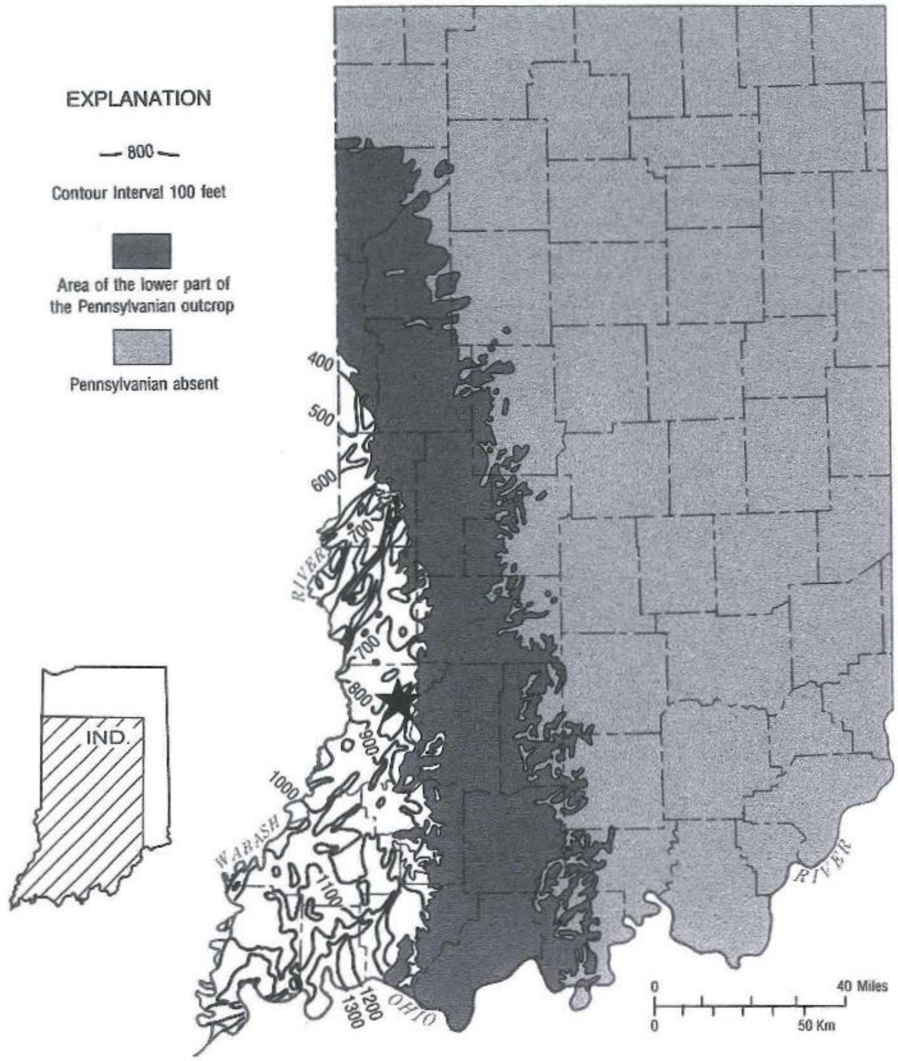
DUKE ENERGY

EDWARDSPORT FACILITY

MAP SHOWING STRUCTURE ON TOP OF THE SPRINGFIELD COAL MEMBER OF THE PETERSBURG FORMATION IN INDIANA

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

SOURCE: RUPP, 1991

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

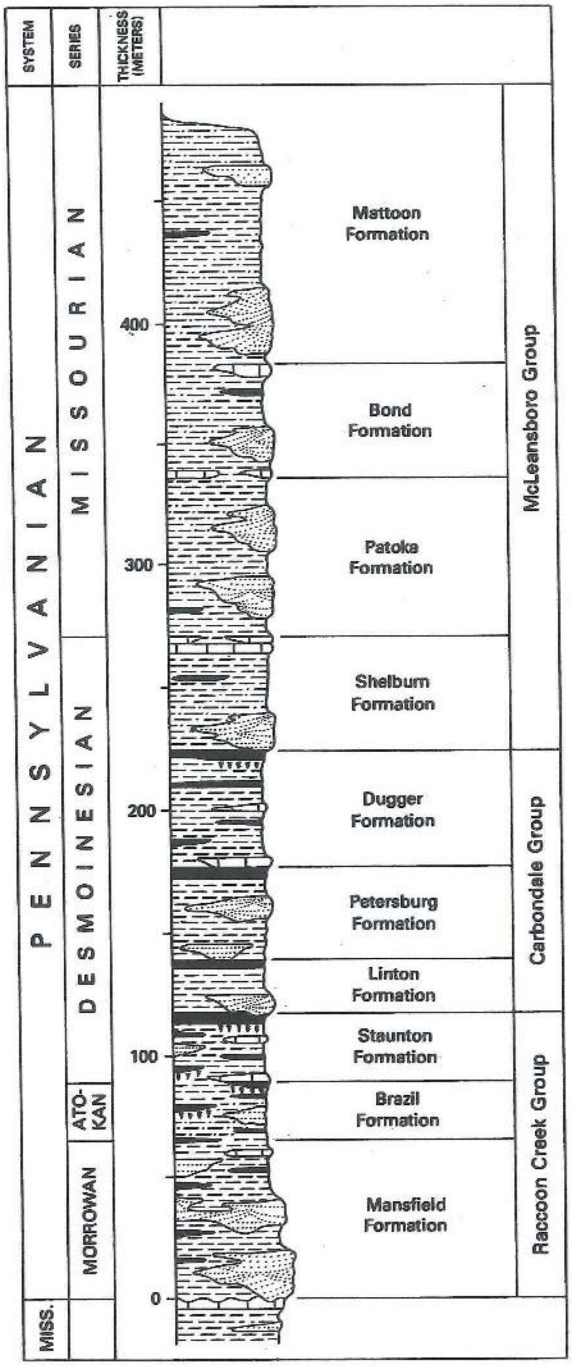
FIGURE F.2.7–4

DUKE ENERGY

EDWARDSPORT FACILITY

MAP SHOWING THE THICKNESS OF THE LOWER PART OF THE PENNSYLVANIAN SYSTEM IN INDIANA

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.2.7–5

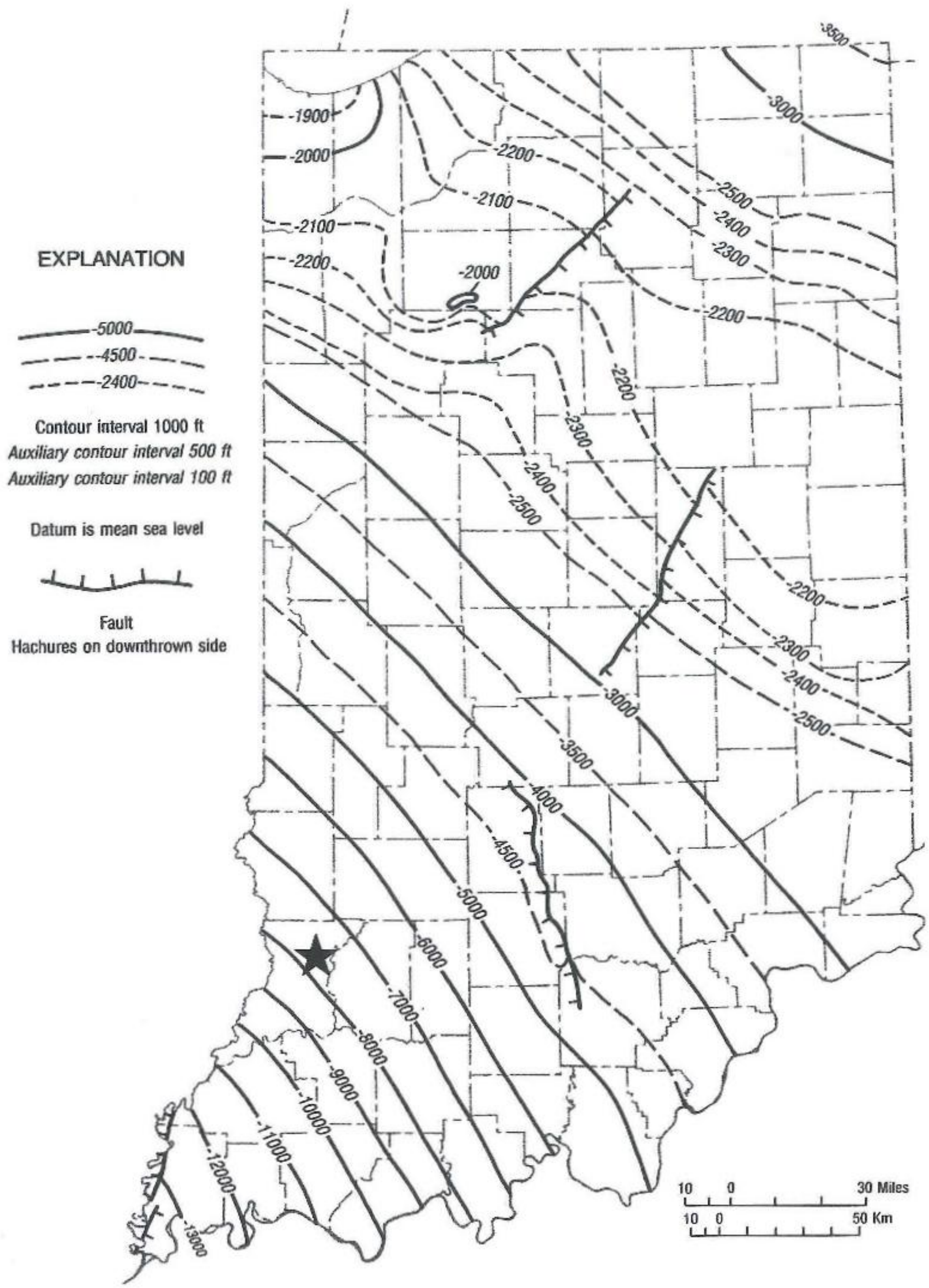
DUKE ENERGY

EDWARDSPORT FACILITY

COLUMNAR SECTION SHOWING EXPOSED PENNSYLVANIAN ROCKS IN INDIANA

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: GRAY, 1979



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.3–1

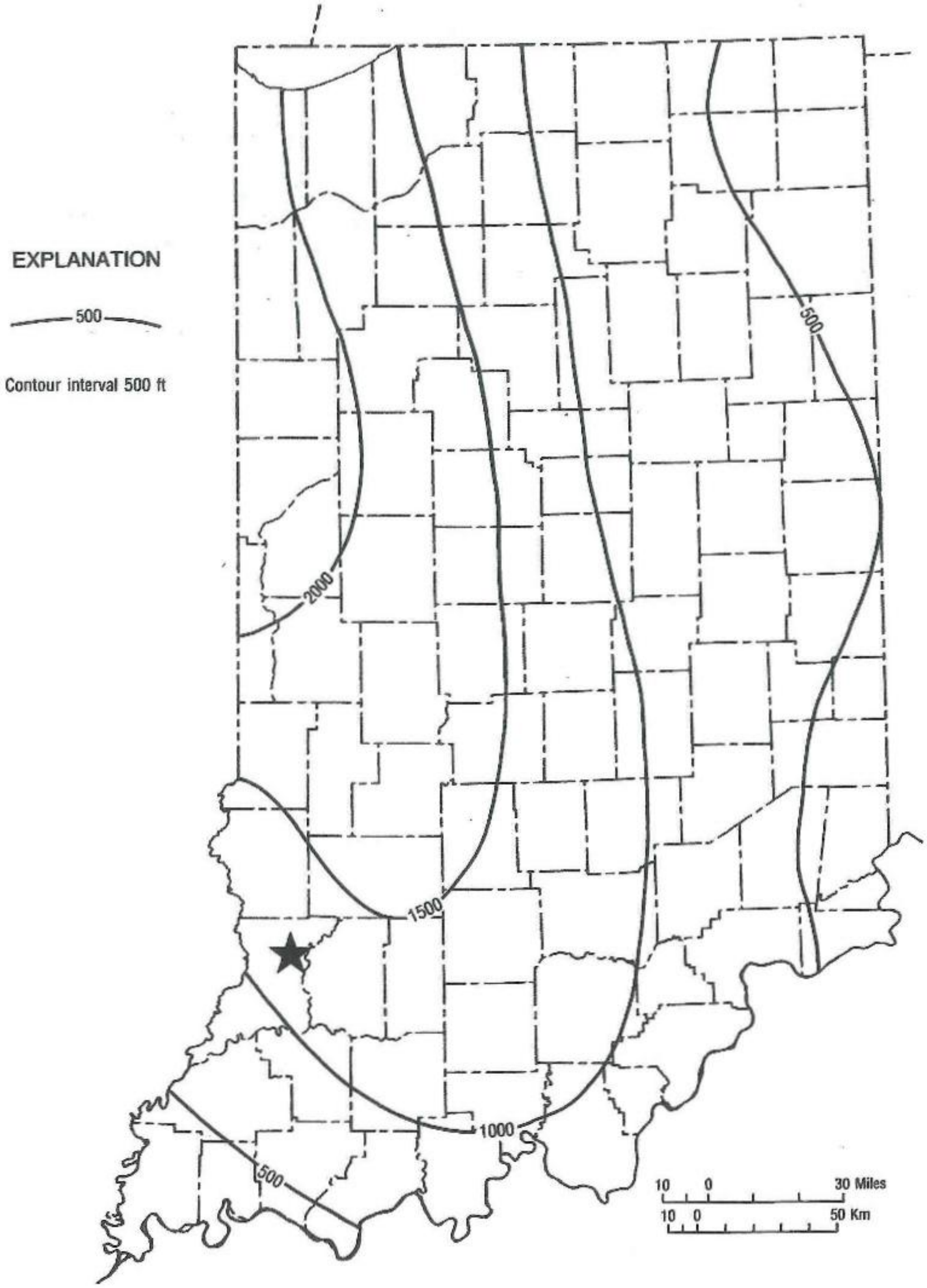
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE MT. SIMON SANDSTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

SOURCE: RUPP, 1991

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

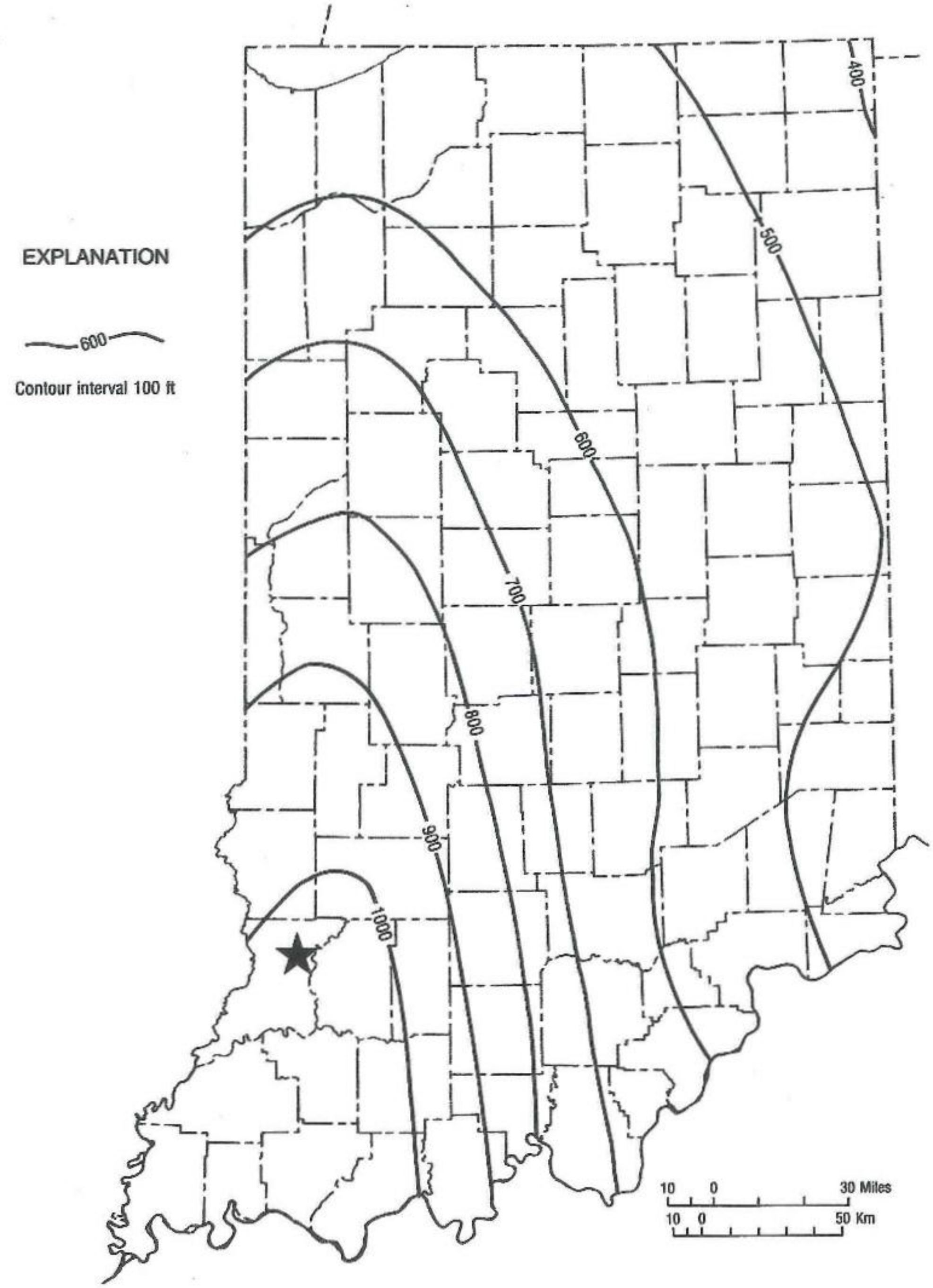
FIGURE F.3–2

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE MT. SIMON SANDSTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60Z5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.3–3

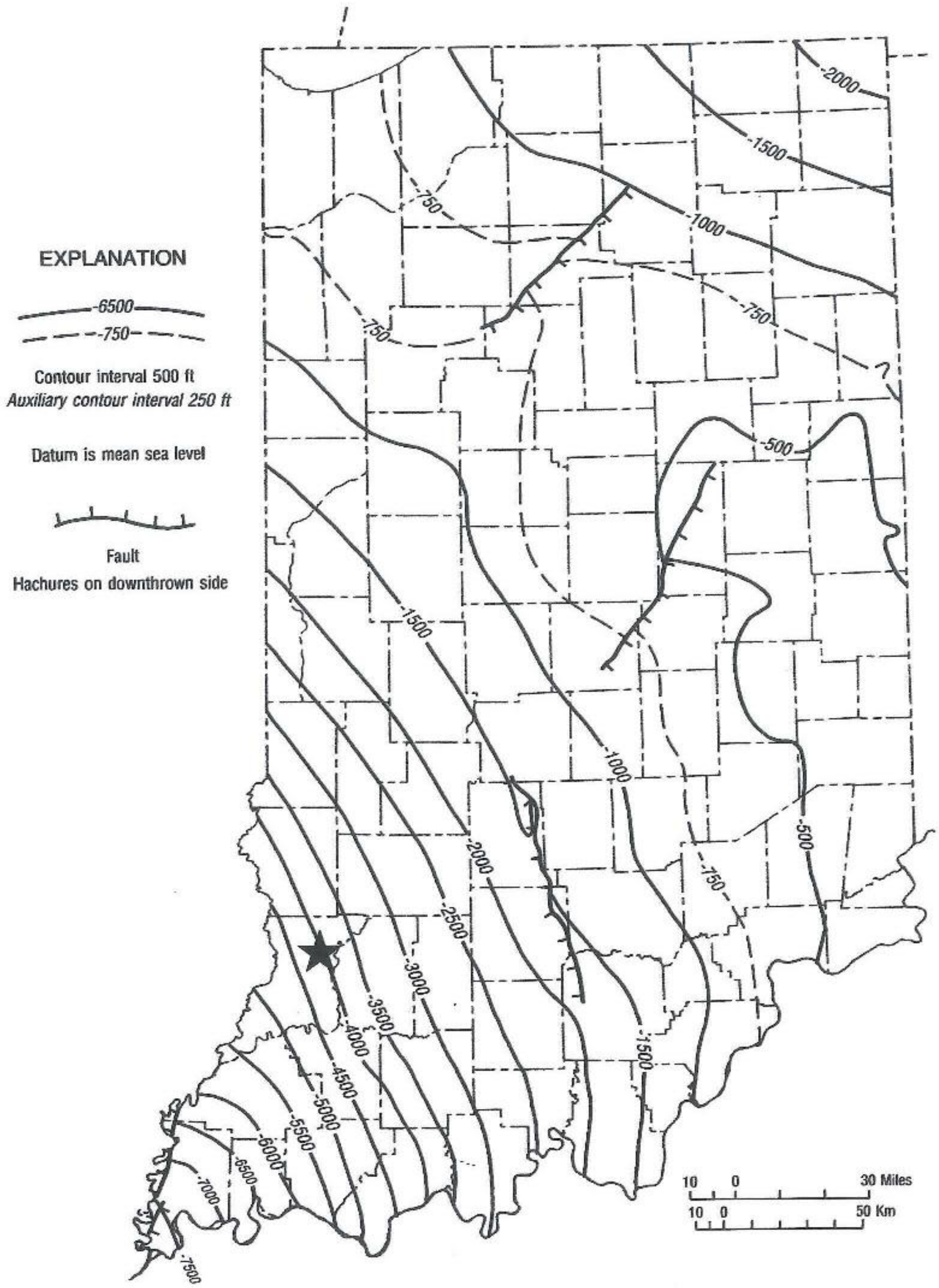
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE EAU CLAIRE FORMATION

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

N

SOURCE: RUPP, 1991

SUBSURFACE	HOUSTON, TX. SOUTH BEND, IN. BATON ROUGE, LA.

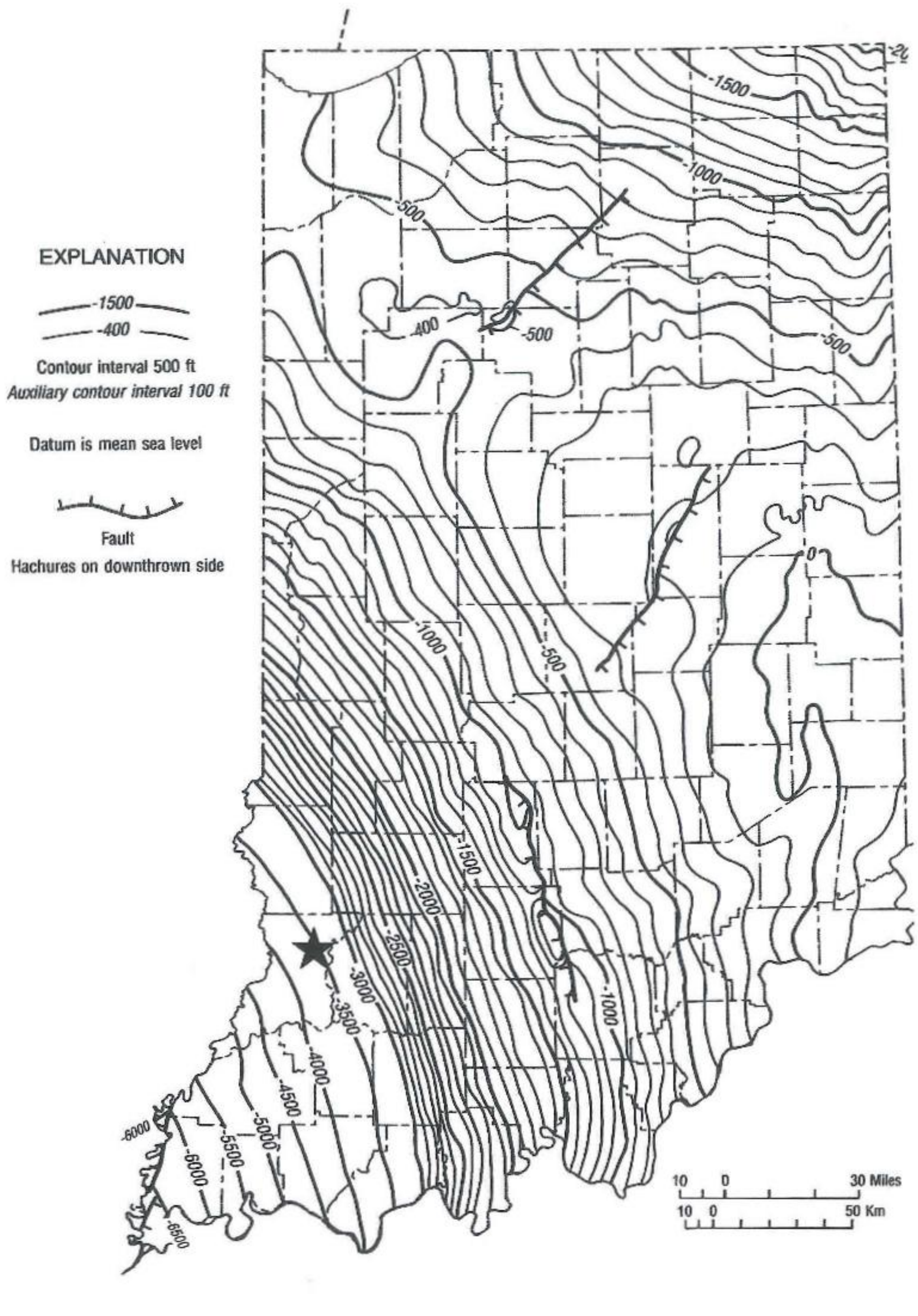
FIGURE F.3–4

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE KNOX SUPERGROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.3–5

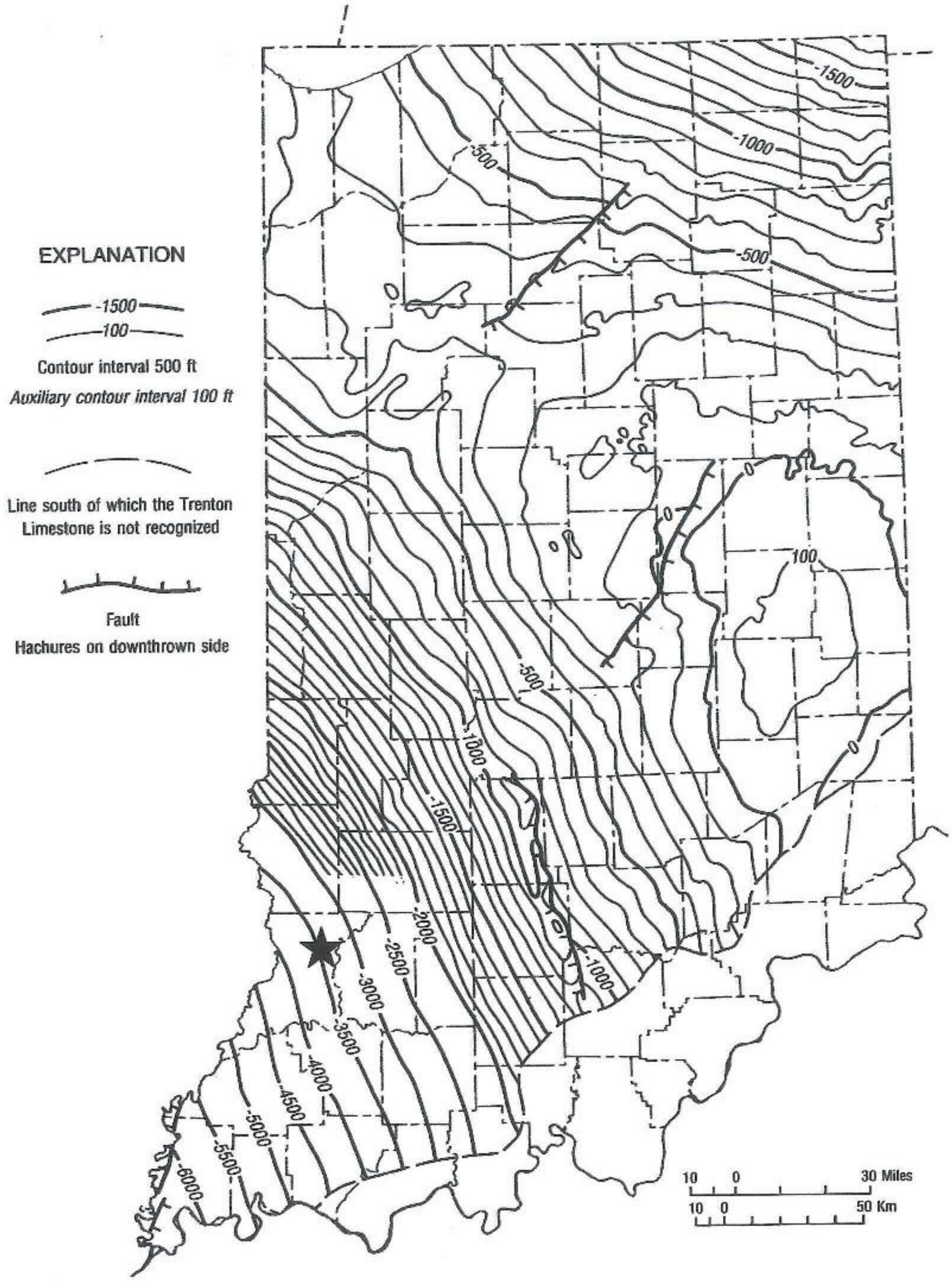
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE BLACK RIVER GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

N

SOURCE: RUPP, 1991

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

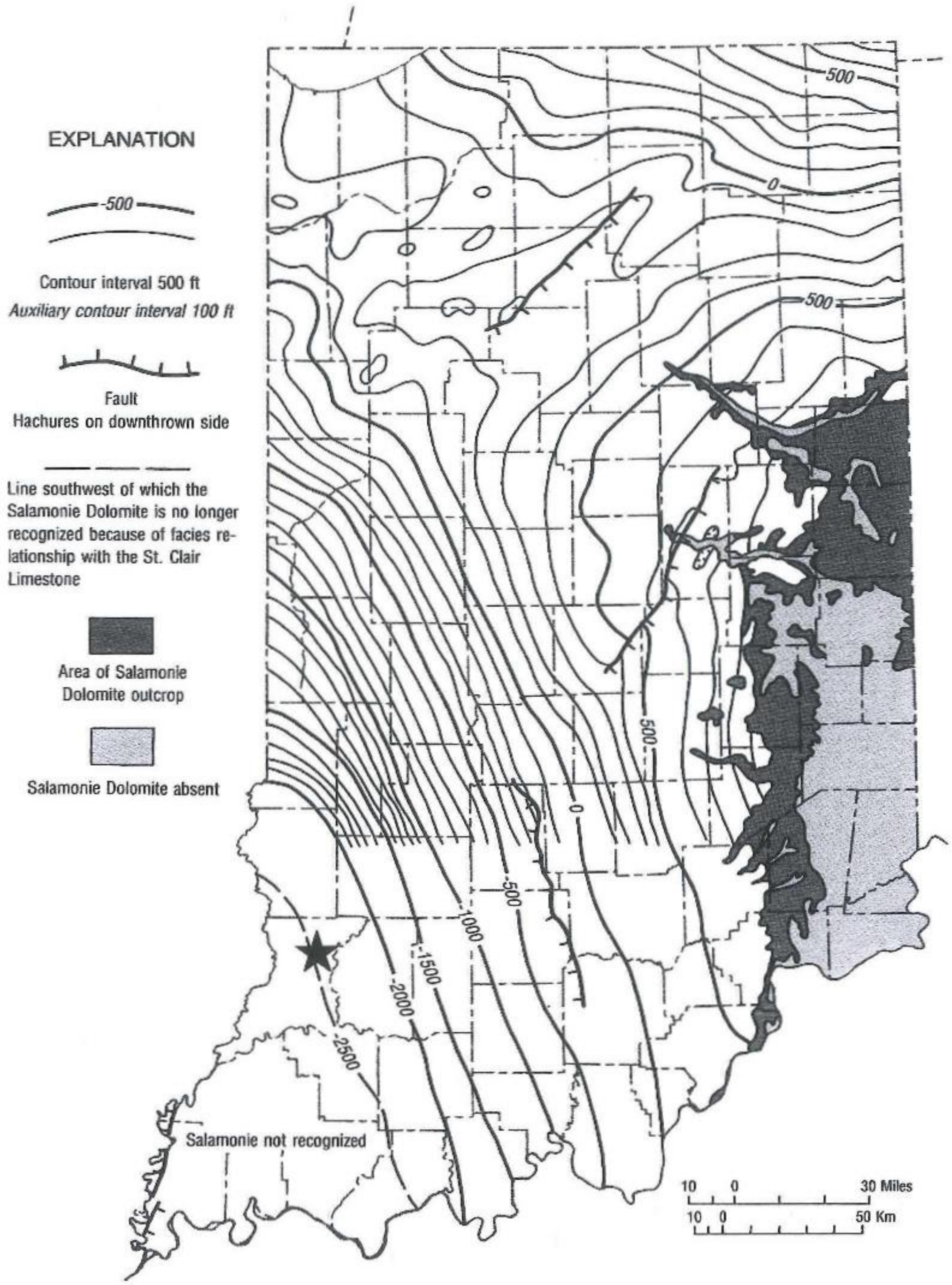
FIGURE F.3-6

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE TRENTON LIMESTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SOURCE: RUPP, 1991

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

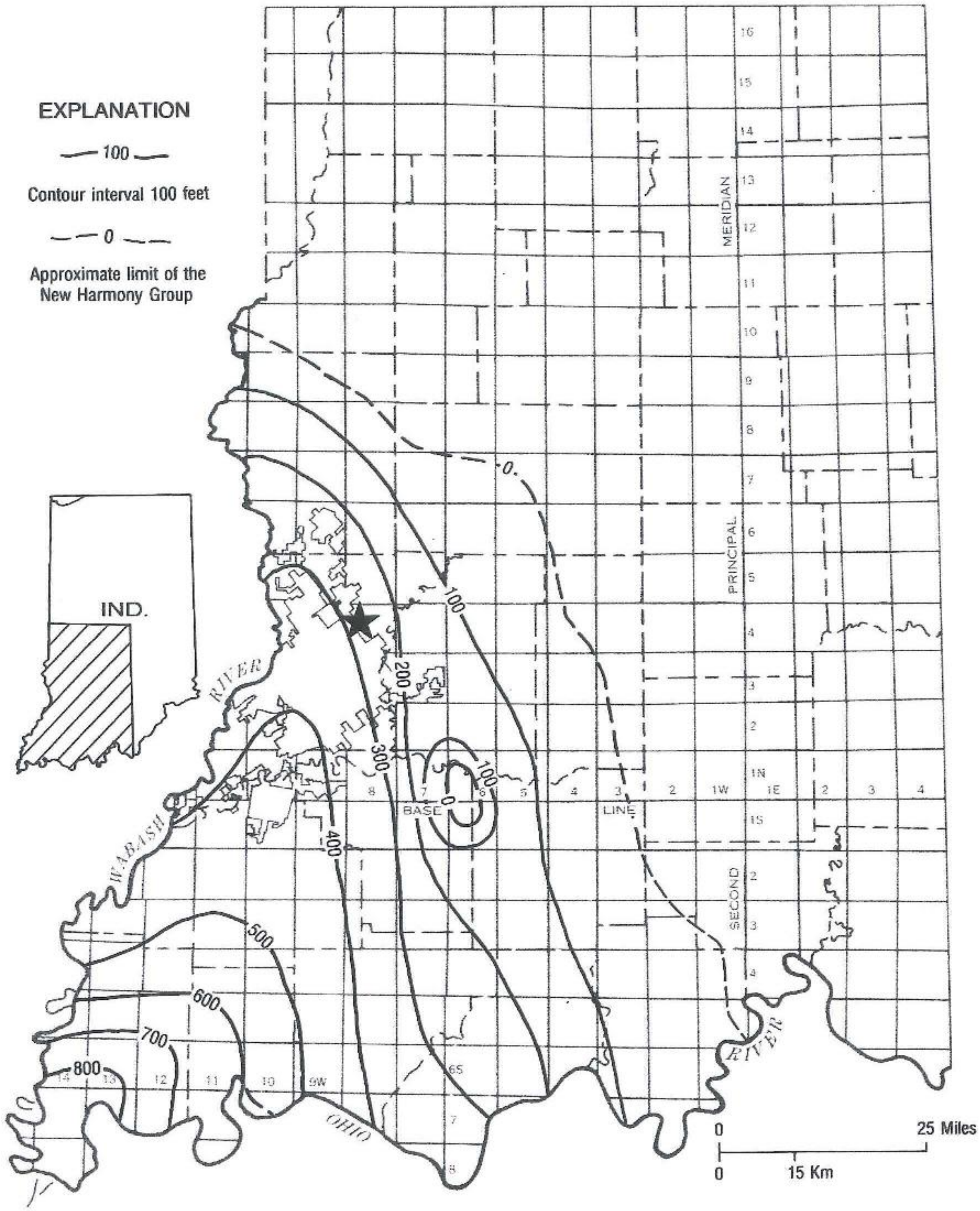
FIGURE F.3–7

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE SALAMONIE DOLOMITE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

SOURCE: RUPP, 1991

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

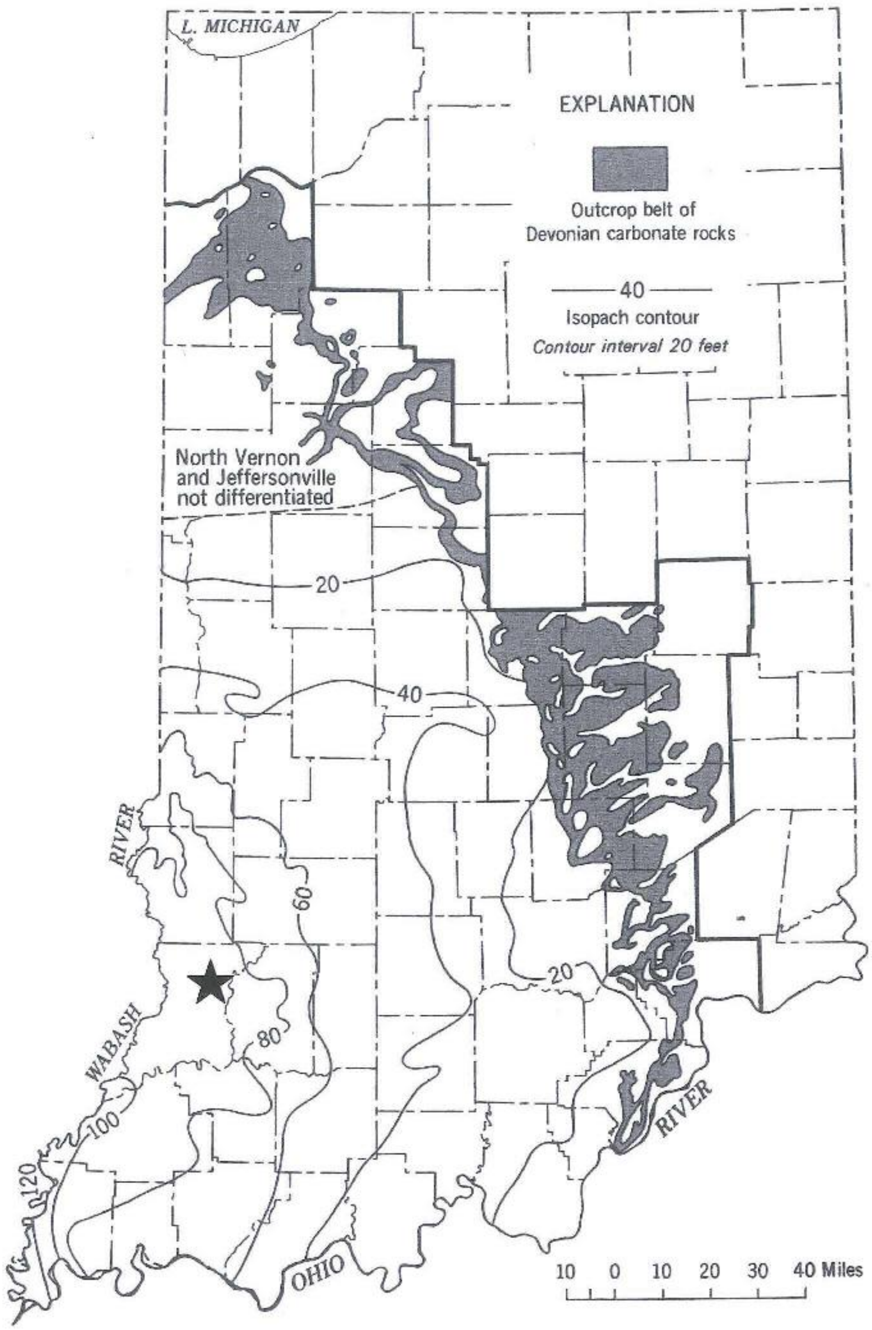
FIGURE F.3–8

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE NEW HARMONY GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.3–9

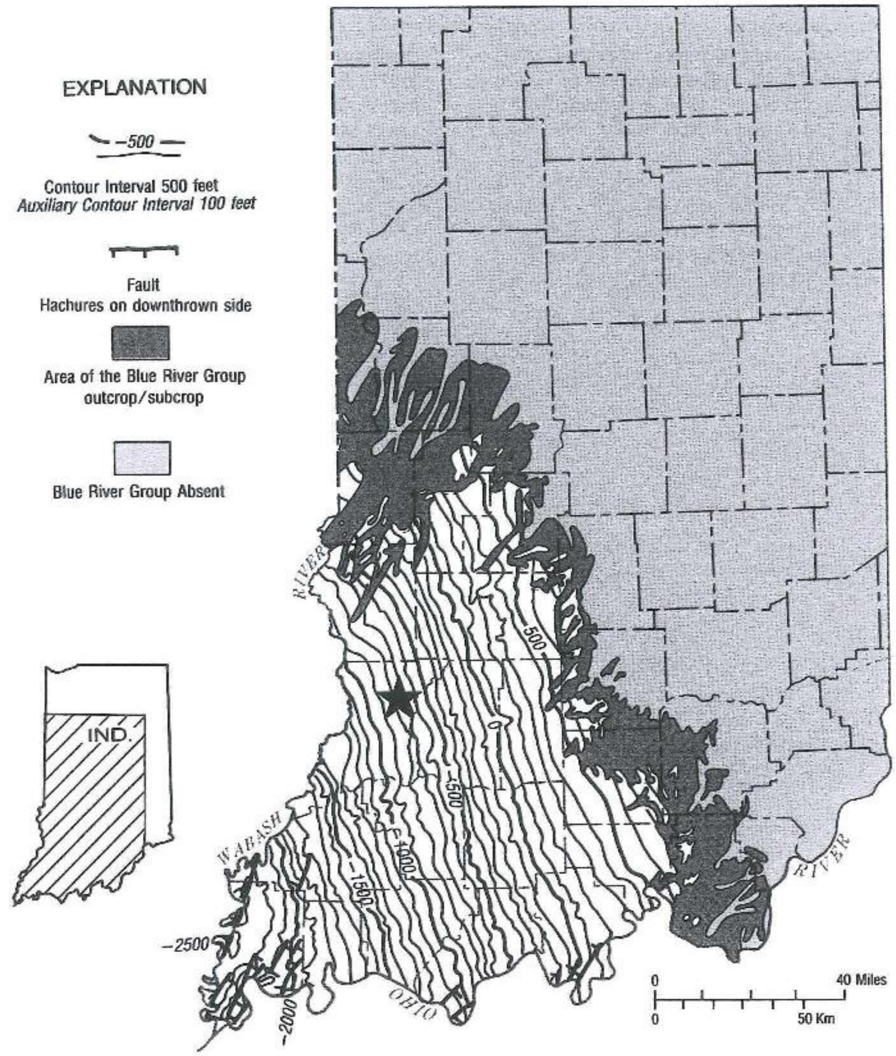
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING
THICKNESS OF THE NORTH VERNON LIMESTONE

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: BECKER, 1974



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.3–10

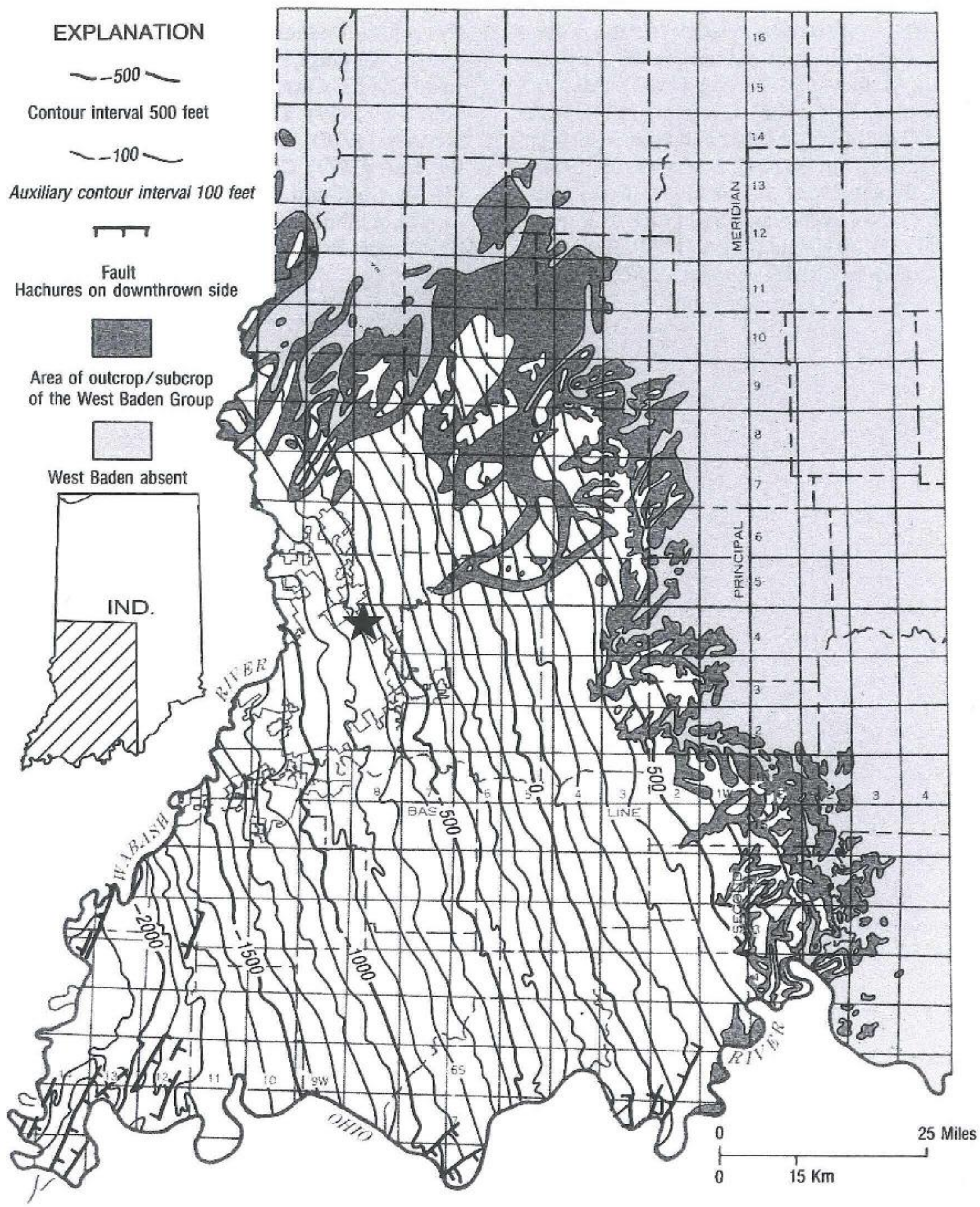
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE BLUE RIVER GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.3–11

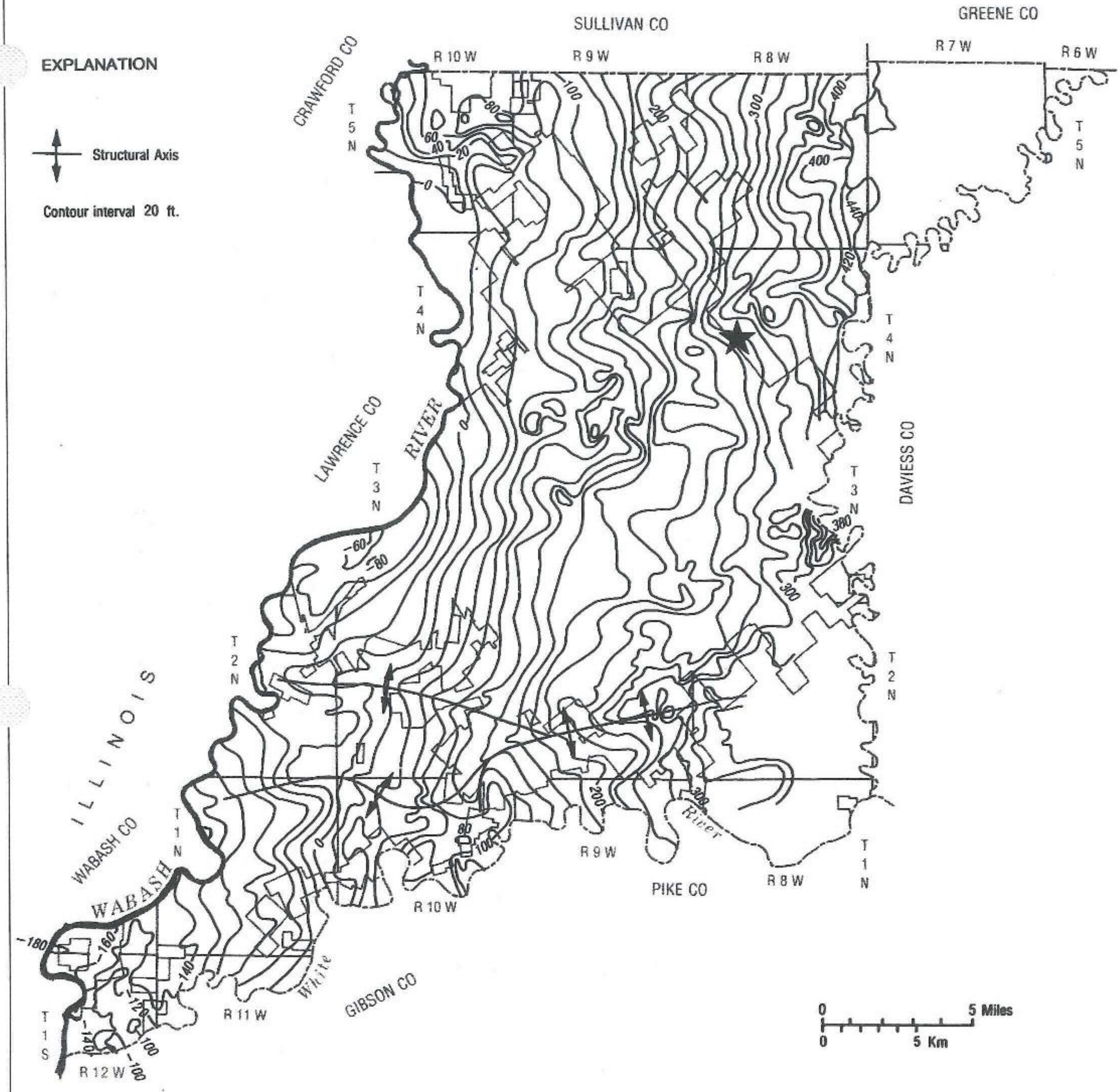
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF INDIANA SHOWING STRUCTURE ON TOP OF THE WEST BADEN GROUP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: RUPP, 1991



LEGEND

★ SITE LOCATION

N

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.3–12

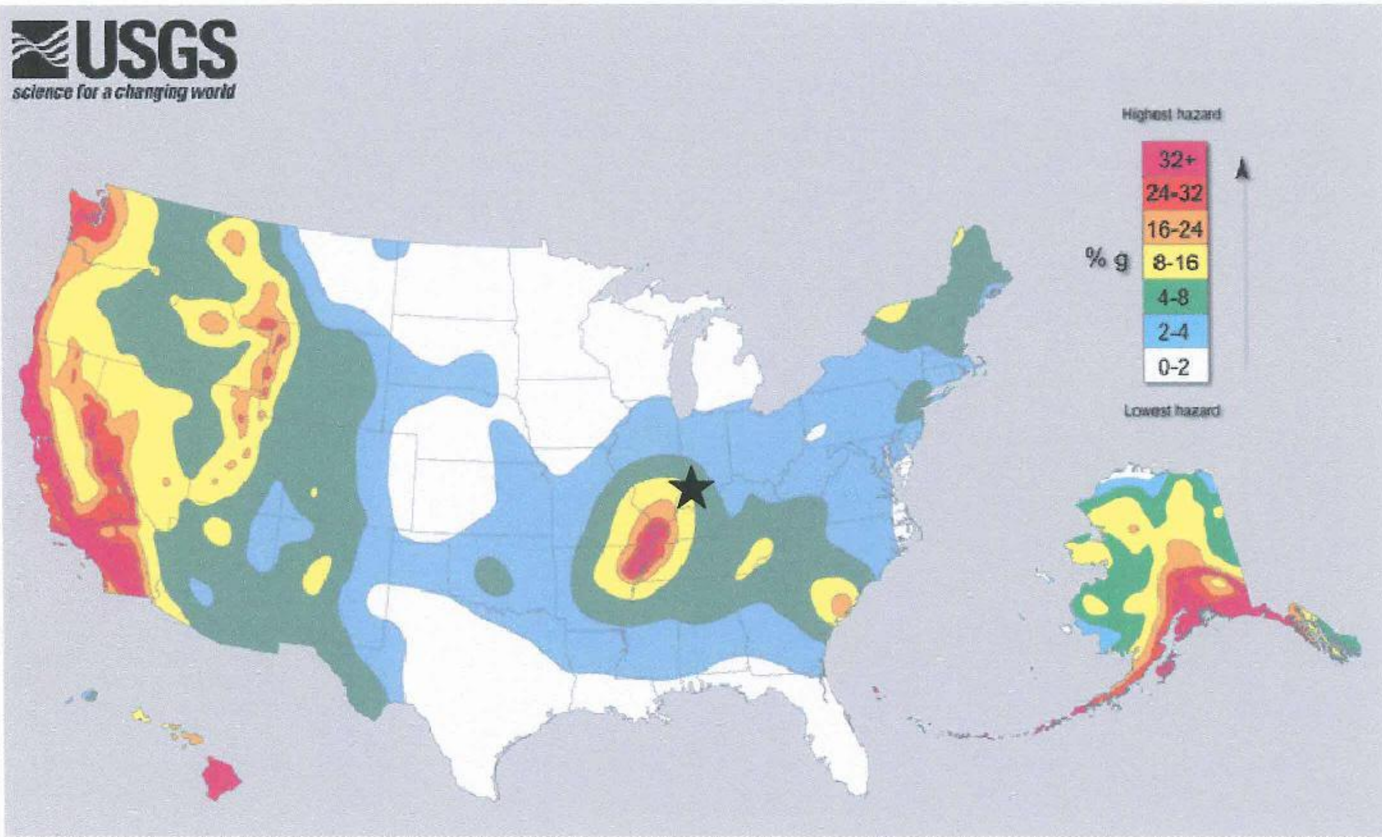
DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF KNOX COUNTY SHOWING THE ELEVATION RELATIVE TO MEAN SEA LEVEL OF THE TOP OF THE SPRINGFIELD COAL MEMBER

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:

SOURCE: HARPER AND EGGERT, 1995



LEGEND

★ SITE LOCATION

N

SOURCE: NATIONAL EARTHQUAKE INFORMATION CENTER

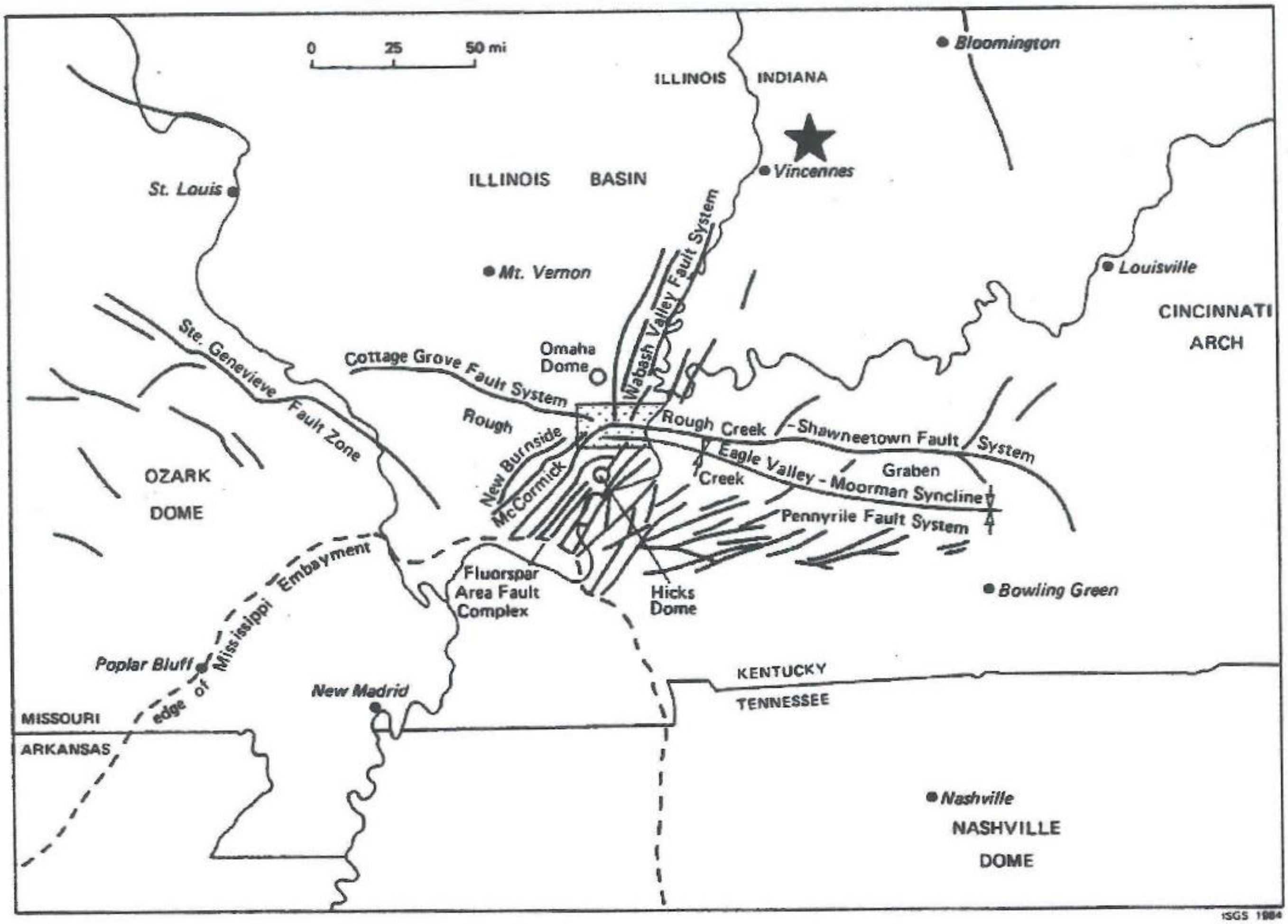
SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.5-1
DUKE ENERGY
EDWARDSPORT FACILITY

SEISMIC RISK MAP

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO:



LEGEND

★ SITE LOCATION

N

SOURCE: NELSON AND LUMM, 1987

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE F.5–2

DUKE ENERGY

EDWARDSPORT FACILITY

MAP OF REGIONAL TECTONIC SETTING ILLUSTRATING LOCATION OF WABASH VALLEY FAULT SYSTEM

DATE: 12/11/06	CHECKED BY: RWS	JOB NO: 60F5923
DRAWN BY: CRB	APPROVED BY: RTB	DWG. NO: